ELECTRICAL ENGINEERING

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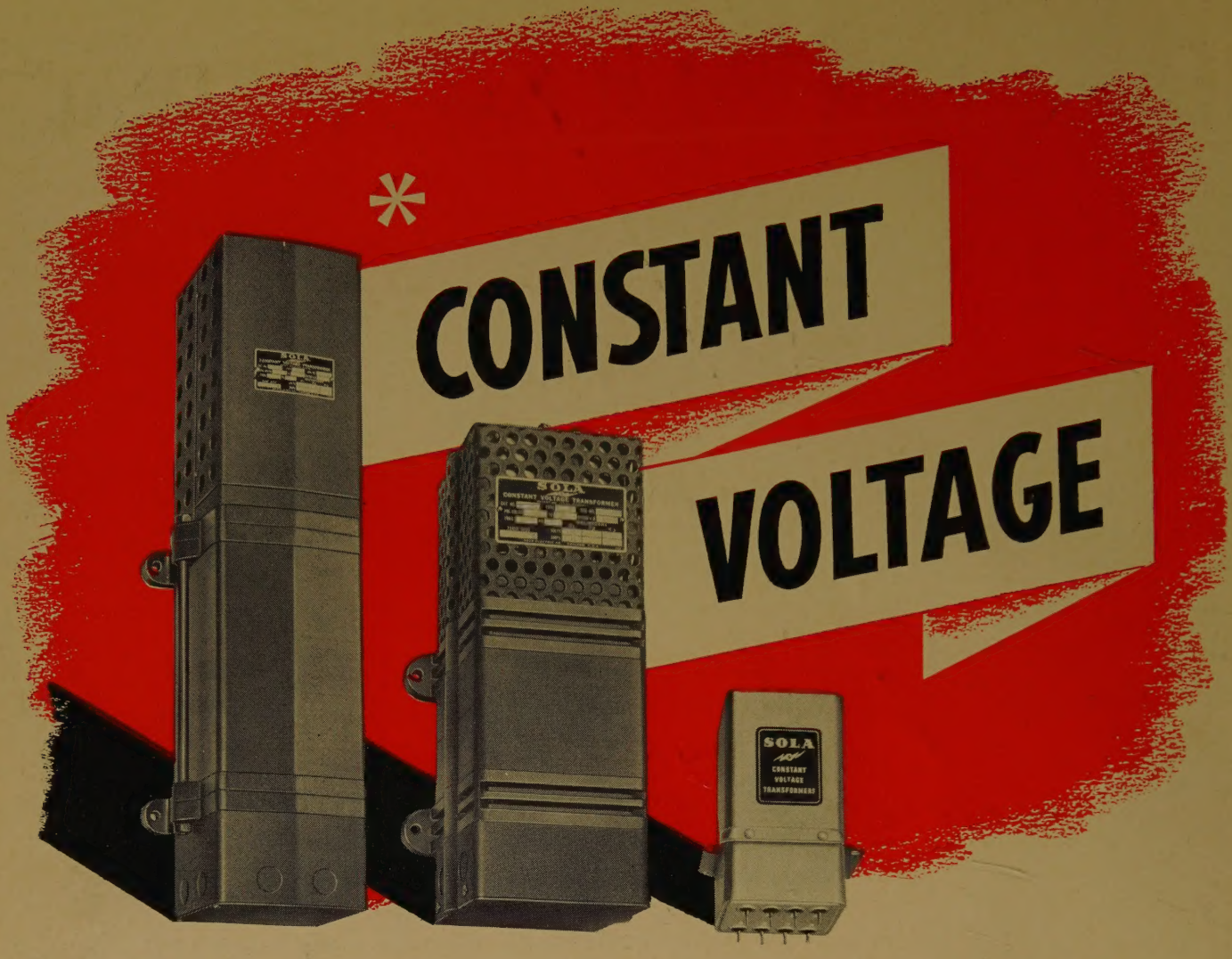

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V-2 Range Control Technique

THOMAS M. MOORE

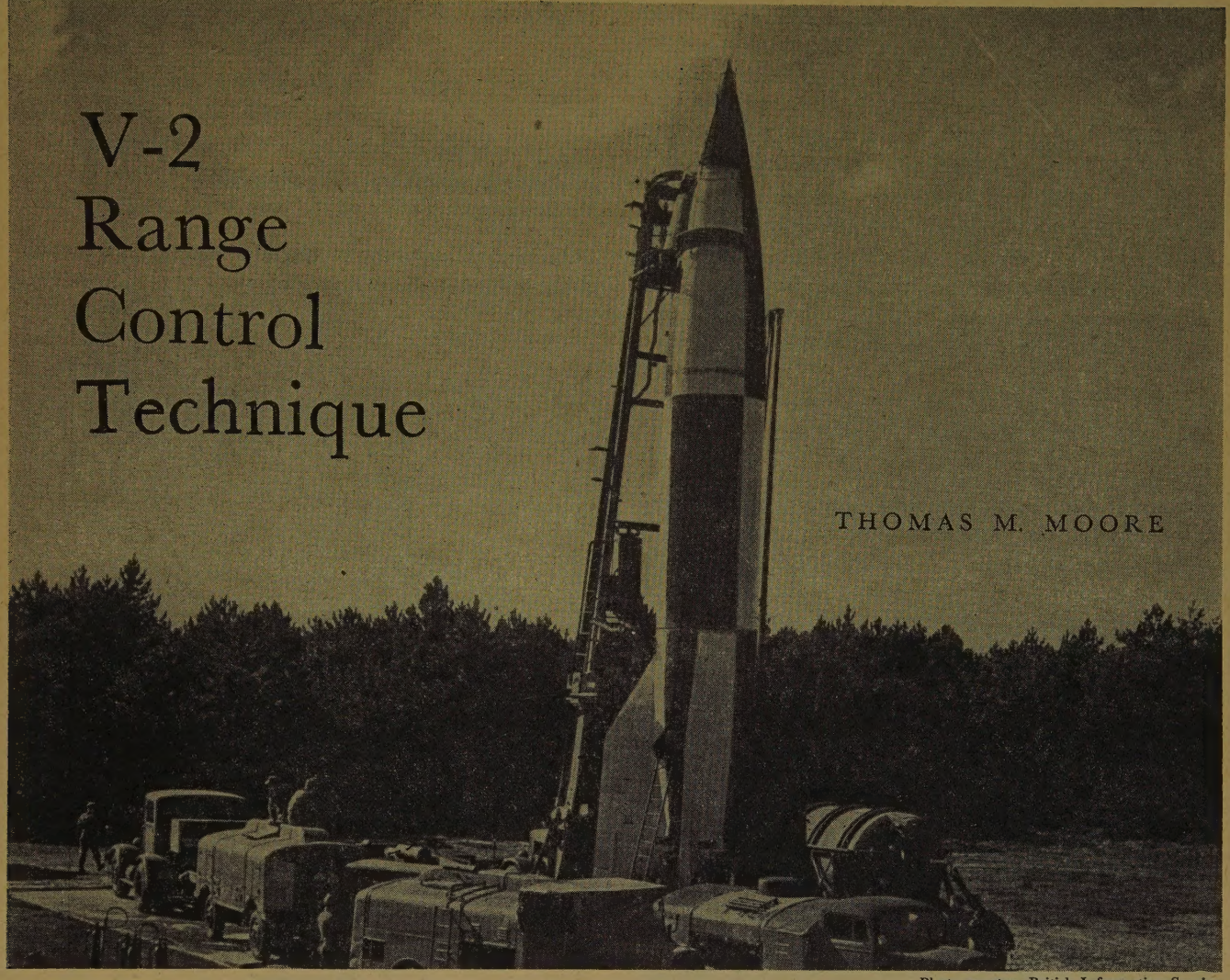

Photo courtesy British Information Service

With the relaxation of military restrictions, information now is available concerning much enemy equipment including the German-developed V-2 rocket which was employed in the bombardment of England. Range control of the V-2 was provided by an integrating accelerometer which, under proper conditions, can be made to give a measure of the velocity at any given instant. By presetting this device and controlling the angle of the missile with respect to zenith, reasonably accurate guidance can be accomplished.

AFTER SOME 20 years of research and development, the Germans successfully launched the first V-2 on Chiswick, England, on September 3, 1944. Although the accuracy of this missile for hitting a pinpoint target could not be depended upon, yet for area bombing it could be expected to land within the area covered by a city.

Before going into a discussion of the means for range control, it is desirable to review briefly the general geometry and launching procedure for this vehicle. At the nose of the missile is the warhead containing the explosive. Behind this is a control compartment which houses means for directing the flight path. Next are two large tanks in tandem containing the alcohol and oxygen. These feed into a combustion chamber and Venturi tube and, when ignited, propel the missile. Two sets of control vanes are located at the rear. One set operates inside the jet stream; the other is located on the trailing edges of four large fins and also is used for flight stabilization.

Upon arrival at the launching site the missile is erected to a vertical position. After the fuel tanks have been filled and the various controls set, the rocket motor is started electrically from a safe distance by means of a cable to the control compartment. The cable is detached at take-off which leaves the rocket to be controlled in flight by its internal mechanism. The rocket starts by climbing vertically and, after reaching a pre-

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determined altitude, is tilted toward the target to a final angle of approximately 45 degrees. This tilting is accomplished by means of a gyroscope-controlled program selector.

Control of range of the rocket is obtained by cutting off the supply of rocket fuel when the rocket has reached a velocity sufficient to carry it to the target. Means for controlling the velocity reportedly necessitated considerable effort on the part of the Germans. They first employed radio Doppler apparatus for this purpose but the system was discarded because of its greater complexity. Later they used two integrating accelerometers.

USE OF THE MECHANICAL INTEGRATING ACCELEROMETER

Many of the missiles launched against England were provided with the mechanically integrating accelerometer shown in Figure 1. The enclosed gyroscope is mounted in such a way as to precess at a rate determined by the acceleration of gravity for test purposes before take-off and at a rate determined by the combined forces

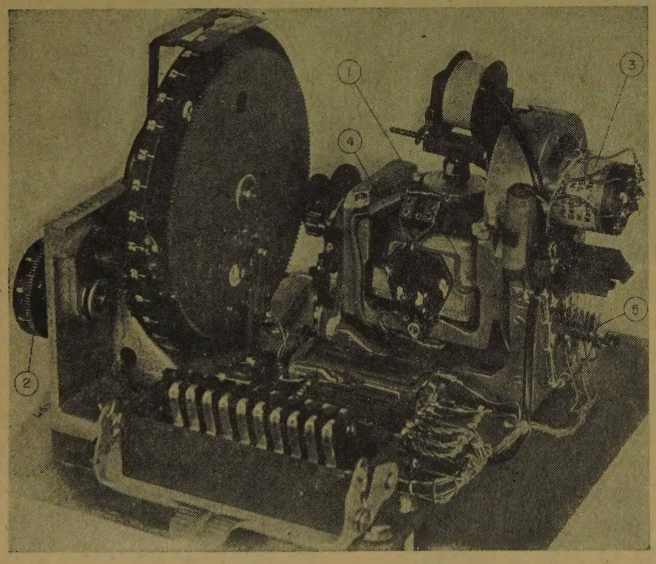

Figure 1. Mechanical integrating accelerometer

1. *Gyroscope*
2. *Preset vernier*
3. *Antifriction motor*
4. *Contact arm*
5. *Slip rings*

of gravity and acceleration of the missile after take-off. From the mechanics of a rate gyroscope we may obtain the following:

$$\frac{d\theta}{dt}=\frac{Kdv}{dt}$$

Integrating

$$\theta=Kv$$

where

v = velocity of the rocket
t = time
θ = angle through which gyroscope precesses
K = constant

An integration of the acceleration then gives a measure of the velocity where K is a convenient stepdown ratio

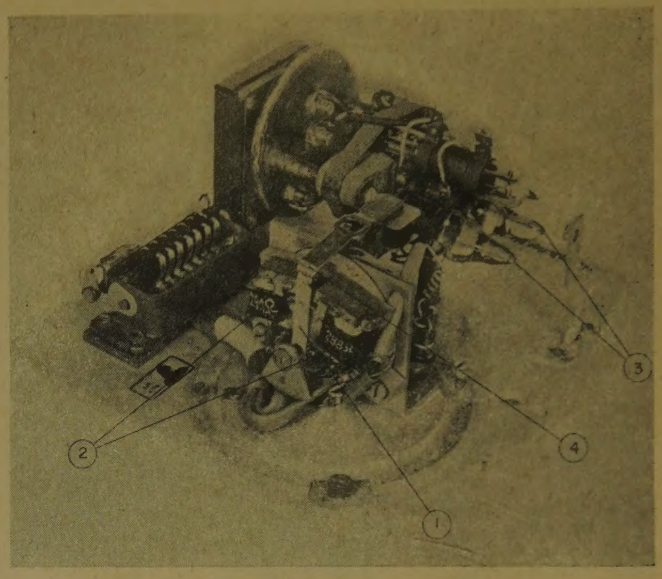

Figure 2. Electrolytic integrating accelerometer

1. *Arm and copper slug*
2. *Electromagnets*
3. *Electroplating cells*

provided by the gear train. Signal for cutoff of the rocket fuel is obtained by means of a cam which actuates a relay when the gyroscope has precessed a predetermined amount. Adjustment of the preset vernier shown in Figure 1 permits setting of the cam to control the fuel cutoff point. The exact setting required is determined from charts which allow for empirical data obtained by test and for a correction for the vertical component of the acceleration of gravity for various tilt angles of the missile while in flight.

As in the afore-mentioned mechanism, if a gyroscope is allowed to precess, the unsupported end gradually will fall as a result of bearing friction so that the precession rate gradually is lessened. In order to offset this error a small 3-phase motor is arranged to drive the gyroscope about its precession axis in order to maintain the contact arm within small limits. This motor, therefore, supplies enough energy to provide an effective frictionless bearing. Direction of the motor is changed by reversing two of the field leads depending on whether

contact is being made in the upper or in the lower position.

USE OF THE ELECTROLYTIC INTEGRATING ACCELEROMETER

Although the aforementioned unit was made with care, a second type of integrating accelerometer proved to be more accurate. This was the electrolytic accelerometer

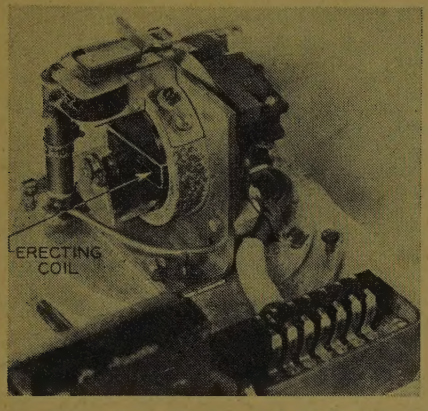

Figure 3. Erecting coil and permanent magnet

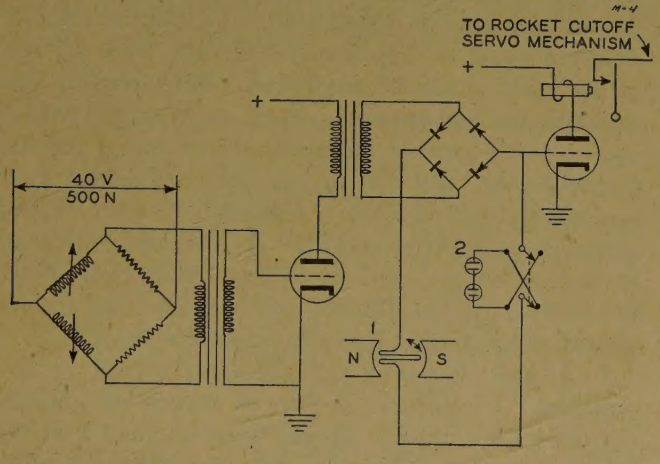

Figure 4. Schematic diagram of electrolytic integrating accelerometer

1. Erecting coil *2. Electrolytic cell*

shown in Figure 2 which was developed under the direction of Doctor Buchold.

In the electrolytic accelerometer an arm is fitted with a copper slug which, when moved within the poles of electromagnets, unbalances a bridge circuit. The signal thus obtained is amplified, rectified, and put through an erecting coil in a permanent magnet field. The coil and magnet assembly are shown in Figure 3. In series with this coil are two electroplating cells (Figure 2) so that the current flowing through the coil and cell units causes a quantity of metal to be transferred within each cell at a rate determined by the acceleration.

Figure 4 shows the circuit external to the components in Figure 3, and is a simulated one set up at the Naval Research Laboratory. For an acceleration of one *g*, the current was found to be two milliamperes at 0.1 volt. The plating cells consist of two silver-wire electrodes of approximately 0.100-inch diameter in a solution of sodium chloride. One of the electrodes in each cell previously has been coated with silver chloride.

By plating a predetermined period of time with the one *g* acceleration available at any launching site a quantity of silver chloride may be deposited on the anodes of the cells. This is removed during the power-on portion of flight at a rate determined by the acceleration of the missile plus gravity.

When all of the silver chloride has been removed from one electrode a signal is obtained as a result of the cell acting as a battery. Metallic silver is formed at the cathode and silver chloride is formed at the anode which causes a voltage to be generated. This force of approximately one volt is amplified and used as a signal to actuate the rocket cutoff relay. This process can be reversed, of course, as many times as desired for test purposes.

Figure 5 shows a recording voltmeter chart of the electrolytic integrating accelerometer during the process of:

(*a*). Plating silver chloride on the unplated electrode.

(*b*). Removing the silver chloride plating.

(*c*). The voltage rise obtained when all of the silver chloride has been removed.

The data shown are for an acceleration of one *g*.

TEMPERATURE REGULATION

Temperature regulation for the cells is provided by a thermostat which controls wire heater elements wound around the glass containers as shown in Figure 4. Power for either accelerometer is furnished by a battery-driven

A—Plate silver chloride
B—Deplate silver chloride
C—Voltage rise (signal)

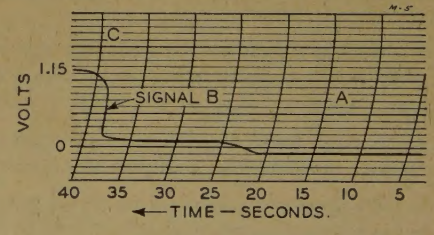

Figure 5. Voltage rise obtained from electroplating cells

motor–generator set requiring 28 volts direct current for the motor and providing a generator output of $42\frac{1}{2}$ volts at a measured frequency of 501 cycles per second (rated 500 cycles per second). The speed of the motor is controlled by a centrifugal governor so that the generator output frequency is held within limits of about two per cent down to 20 volts input to the motor.

Experiences With the Control Council in Germany

C. A. POWEL
FELLOW AIEE

Significant and controversial are these bold and frank comments of an AIEE past president, based on first-hand observation and study over a period of some nine months since the military collapse of Germany. Here is food for serious thought and a challenge to American policy and security. Comments and opinions on the subject are invited.

YOU HAVE BEEN told time and again that we are bungling the job in Germany, that we have no foreign policy, and that we are headed for World War III or for the rocks. It would seem that such a unanimity of opinion must have some foundation in fact. After living for some nine months in daily contact with the problem, I have come to the conclusion that the cause of our troubles is not so much quadripartite disagreements, denazification, fraternization, and other surface manifestations we read about, as it is the basic folly of the Potsdam Declaration and the unstable organization with which it is being implemented. The best management in the world could not run an organization efficiently with a complete turnover of personnel every three or four months, particularly when the task given it is so full of contradictions as the Potsdam document.

The Potsdam Declaration has a dozen or so clauses, which when read over casually sound as innocent and reasonable as the Atlantic Charter, but when analyzed take on an entirely different aspect. In very general terms the Potsdam Declaration stipulates that:

1. Germany shall not be enslaved, and the Germans shall be given an opportunity to re-educate themselves along democratic lines. Germany shall be treated as a single economic entity.

2. Nazism must be eradicated, completely and active Nazis must be removed from positions of influence.

3. Germany must be deprived of her power to make war, and her industrial capacity to wage war must be removed or controlled.

4. Germany will be left enough productive capacity to meet the needs of the occupying forces and displaced persons in Germany and to provide a standard of living not exceeding the average of those of surrounding European countries.

5. Germany will be permitted to produce enough food and light industry to subsist without external assistance according to the permitted standard of living, and to export enough to pay for essential imports.

6. Germany must furnish reparations in the form of industrial capital equipment to the countries against which she waged aggressive war. In addition to the reparations to be taken by Russia from her own zone, she will obtain 25 per cent of the surplus capital equipment in the Western zones.

These terms seem very moderate when one considers the enormity of the German crimes, and if Germany had had as little contact with the rest of the world as, let us say, Russia or Afghanistan, no doubt the terms of Potsdam could be implemented literally, and the rest of the world would be unaffected. But Germany was an important and essential unit of our Western civilization and the greatest industrial power except for the United States; and how we can expect to destroy such a power and still maintain a permanent or even lengthy period of prosperity is not clear. It is as though we were to remove 60 per cent of industry from New York, Pennsylvania, Ohio, Illinois, and Michigan and expect the rest of the United States to enjoy prosperity.

I am not advocating that Germany should go unpunished. I appreciate as fully as anyone the charges that have been brought against Germany, and I would be the last to claim that they are unfounded, or that we need have no fear of another Bismarck or Hitler. The Germans for generations have been used to implicit obedience to a higher authority, and this trait in their characters will not change overnight. They never have known freedom of speech or freedom of action as we understand it. When I was at school in Switzerland, I became by chance quite intimate with one of Germany's great historians, Carl Bleibtren, a very brilliant man. He had been kicked out of Germany for daring to question whether Germany was really a democracy. And that, gentlemen, was in the opening years of this century—long before the first World War.

REPARATIONS AFTER WORLD WAR I

I also appreciate that after the first World War we all were fooled by the Germans, and that our attempt to collect reparations helped them. Britain took the German Merchant Marine to replace her ships sunk by submarines. She got old ships, while the Germans got

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Full text of a luncheon talk at the AIEE Southern District meeting, Asheville, N. C., May 14, 1946.

C. A. Powel, who is a junior past president of AIEE, was chief of the electrical and radio branch of the Allied Control Commission in Germany.

new, better, and faster ships built with American money. France took coal which she formerly bought from England and so upset her trade balance with that country. Germany got nice new factories also built with money borrowed from the United States. In fact, what little reparations Germany paid were paid with American money, but even so she put up such a hard-luck story that we all called it quits. The German Republic under Friederich Ebert was admittedly a farce fully controlled by the same old war lords, who lost no time planning for the next war.

All this is historical fact, and we would be foolish indeed to ignore it. Germany must be disarmed and her war potentiality completely eliminated, but this end can be achieved without going to all the complications and extreme lengths stipulated by Potsdam, and wrecking the economy of Europe for years to come. I still stand behind the suggestion made in 1944 by the presidents of the five leading engineering societies, of whom I was one.[1] This program would have deprived Germany completely of her power to make war, but she could have gone ahead and rebuilt her peacetime industries and helped lift the countries around her out of the present confusion. Potsdam makes this impossible.

GERMAN POSITION IN EUROPEAN ECONOMY

For the past 40 years, all advanced thought has been on the side of improving the standard of living of all peoples—for idealistic reasons on the part of some, for selfish reasons on the part of others. Prosperity grows in a geometric progression; conversely a depression anywhere soon spreads in ever widening circles to involve the whole industrial world. Any scheme, therefore, that starts out by "reducing the standard of living" of some 70 million people is not based on very intelligent thinking. The war has not changed the geography of Europe. The distribution of its natural resources, arable land, and population remain essentially unaltered, and, no matter what political structure is given to that part known as Germany, it cannot be treated as an independent and unrelated part of European economy. Reducing the standard of living of the Germans is bound to reduce the standard of living of the Poles, Rumanians, Austrians, Hungarians, Czechs, and others who are inextricably linked economically with Germany. Before I left Berlin, we already were being deluged with requests from all over Europe for repair parts for machinery and automobiles built in Germany. If a Pole cannot operate a machine for lack of a part which a German cannot provide, because his factory has been turned in on reparations, I don't know who is the loser, the Pole or the German—certainly we are not adding to the Pole's prosperity or raising anybody's standard of living.

A large part of Germany's industrial structure has been wrecked, but there still remains in Germany a foundation of highways, railways, power systems, communication systems, industrial establishments, and a supply of skilled labor unsurpassed anywhere, and so superior to that of the surrounding countries, that there appears to be no grounds for assuming that manufacturing plants removed under reparations from Germany to surrounding countries can in any foreseeable future play their former role in European economy. Indeed, from what we observed of the removal of German plants by the Russians, it is questionable if the equipment will be fit to put up anywhere.

It probably is not realized generally that this reduction of the standard of living of the Germans to the average of Europe is no minor operation. For instance, steel producing capacity will be cut from a war peak of 28 million tons annually to 7.5 million tons; machine tool producing capacity will be 11 per cent of prewar value; heavy electric equipment and heavy engineering generally will be 30 per cent of prewar value; and so on. Even when war damage is taken into account, there still will be much plant and equipment to be made available for reparations.

POTSDAM'S CONFLICTING CLAUSES

The Potsdam agreement says that Germany is to be allowed enough resources to be self-supporting and sufficient exports to pay for essential imports. Originally it was the intention that Germany also should pay for the costs of occupation. This, too, sounds reasonable. Certainly there seems to be no good reason why the American taxpayer should pay for whatever army and military government is necessary as a result of crimes perpetrated on the world by Germans. But, unfortunately, the answer is not that simple. It was soon evident that, if Germany was to pay for imports and for the army of occupation, exports would have to be of the same order as during her best years, and any idea of reducing her industrial capacity was out of the question. As it is, she probably is going to find it difficult to export enough to pay for essential imports. We still are tearing down in order to meet this "average standard of living" clause. We are rebuilding nothing. Even without this complication, the German export situation would not be particularly happy. Under the Nazis, exports were stimulated artificially by subsidies. It still remains to be seen what business they can obtain in a free competitive market.

The primary objective of the war was to put an end to German aggression, to prevent her periodic attacks on her neighbors. Our armies did a magnificent job of reducing her to the point where she would listen to reason, but, unfortunately, when they were through, "reason" was not forthcoming. In its place came an outmoded revenge philosophy, which in due course will disgust all decent people and will result in total withdrawal from Germany, which then will be free to resume its old policies.

INDUSTRY CURTAILMENT BY ENGINEERS' PLAN

I have no way of knowing who is primarily responsible for Potsdam, but in his book "Germany Is Our Problem," Henry Morgenthau seems to take most of the credit for it. The proper course already had been suggested in the document submitted by the presidents of the engineering societies.[1] Germany could have been rendered helpless to wage war by:

1. Elimination of all factories manufacturing war equipment solely (shell loading plants and the like).
2. Elimination of plants manufacturing aircraft and aircraft parts and control of imports.
3. Elimination of plants manufacturing primary aluminum and magnesium and control of imports.
4. Elimination of all synthetic oil capacity and control of imports.
5. Elimination of 75 per cent of Germany's synthetic nitrogen plant capacity and control of imports.
6. Elimination of 50 per cent of Germany's steel making capacity with particular emphasis on heavy forgings and high alloy steels.

An analysis of this program will show that, while it makes the waging of war impossible, it does not necessarily reduce the German standard of living. An aircraft industry depending only on peacetime requirements cannot be self-sustaining. The total German requirements would be less than 100 planes a year. There is no bauxite in Germany and, therefore, no justification for an aluminum producing industry. They can import aluminum ingots, more profitably and such imports can be controlled. Their steel manufacturing capacity was very much overexpanded, and their production costs were high compared to United States and British costs. Elimination of the old inefficient mills would have helped their cost position.

The implementation of such a program would have been simple, whereas the complications resulting from the Potsdam formula are quite formidable. I have sat in meetings of the four occupying powers in which we have discussed for hours whether the Germans should be permitted to build 20,000 machine tools or 30,000 machine tools a year; 35,000 tractors or 40,000 tractors. All this was made necessary by this arbitrary "standard of living" required by the Potsdam agreement. It took a corps of experts six months to determine what constituted a "standard of living," and when they were through, it was still just an opinion.

The excess capital equipment left over after determination of what the Germans are permitted to keep to satisfy this "average standard of living" is to be turned over to the allied nations in the form of reparations. One would suppose that the Allies had learned after the last war that reparations are a snare and a delusion. "Lend-lease" was "lend-lease" only because we recognized the futility of trying to collect international debts. But at Potsdam we still talked of reparations.

The Germans are a highly intelligent, industrious, and practical people. They have the peculiar characteristic of making work an end in itself. What they produce seems to be a secondary consideration, so long as they are producing something. One would suppose that the intelligent thing to do would be to take advantage of this characteristic and make them produce more and more for the benefit of the surrounding devastated countries. Instead of this we are taking away from them what plant is left from the bombing and general destruction and putting all kinds of hindrances to their efforts at working. This hardly seems to be a policy leading to permanent peace.

RUSSIA'S NON-CO-OPERATION

The Russians have invited large numbers of German experts and scientists to Russia. This is very nice for Russia, but not very useful to the other devastated countries, nor is it calculated to raise the standard of living of Europe. If anyone has any idea that co-operation can be expected from Russia, I don't know on what it is based. There was no evidence of co-operation in Germany. The Potsdam agreement among other things requires that "Germany shall be treated as a single economic unit." Never has a clause in any document been ignored so completely. The fact is we do not have the least idea what Russia is doing or intends to do east of the Elbe, except for what she wants us to know, which is remarkably little. Visits into the Russian zone are prohibited, and censorship of news is complete. We do know, however, that Russia is working assiduously at introducing communism (that is, state monopoly of every activity) throughout the whole district. The Allgemeine Elektrizitäts Gesellschaft plants, for instance, that are in the Russian zone in Germany have been turned over to "public trustees," whereas the plants in the other zones still are under private ownership. The Russians also have confiscated land in their zone from the rightful owners and turned it over to the so-called peasants. This they call "land reform." This is, of course, one of the main planks in the communist doctrine.

As you will have gathered from my remarks, the Potsdam agreement, in my opinion, is not helpful toward solving the world's troubles, but Potsdam is not a peace treaty and was not intended to be permanent. In course of time a peace treaty will be evolved, which must not be permitted to perpetuate the stupidities of Potsdam. This is my only excuse for speaking.

PEACE TREATIES CAN REMEDY SITUATION

In the final treaty there must be a return to those principles on which our Christian religion is based. Oriental revenge may be sweet, but history shows that it never helped the practitioners on any long-term basis. Punishment of the individuals responsible for bringing on the catastrophe and those involved in atrocities certainly is called for, but going beyond this is wrong

from both a moral and a practical point of view, even though Germany as a nation certainly was solidly behind Hitler.

We also should cease pretending that Russia is our ally. Our dealings with her have been and still are entirely one-sided, and there is not the least indication that she intends to change that policy. Russia is interested in Russia and in nothing else. Co-operation and compromise are words that do not exist in the Russian dictionary. We permit the Russians to see anything they wish in our country, but we know nothing of what goes on in Russia. In Berlin we found them better informed on the machine tool industry in the United States than we were ourselves.

For some reason never satisfactorily explained, Russia was permitted to take much more of Germany than she really conquered. American troops could have been in Berlin long before the Russians if so permitted, and with much less bloodshed, because the Germans resisted the Russians but would have surrendered without fighting to the Americans. In all that part of Europe overrun by the Russians, including the Russian zone in Germany, we know little of what is going on, and what little we know does not make pleasant reading. All the evidence points to the fact that they are setting up communist governments responsive to Moscow only. It is difficult to believe that in any free election, the Poles, Czechs, and others would vote for government monopoly of the Russian type with all producers at the mercy of a single master and without the least vestige of liberty of speech, liberty of movement, liberty of ownership. The past history of those countries shows no indication that that was what they wanted. Hitler offered them more or less the same thing, and their reaction was rather violent, as I remember it. But the Russians are past masters at setting up left-wing movements in other countries, and then sitting back to await results. Ordinary common sense would seem to tell us that, if the Russian system is as good as they would have us believe, there would be no need to hide it behind what someone has called an "iron curtain."

GERMANY MUST BE ENTITY

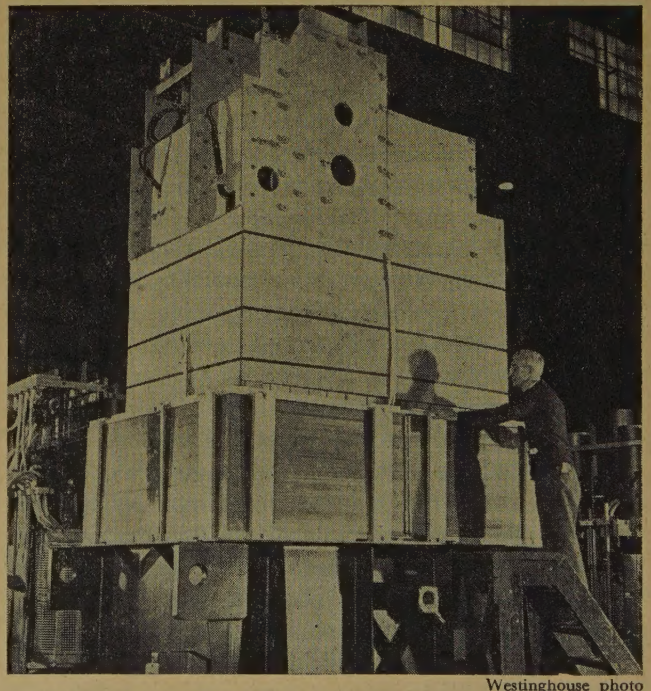
This brings me to the next point. Germany must be treated as a single economic entity. Even Potsdam recognized this, but nothing is being done about it. The Russian zone is the bread basket of Germany and must be made available to all of Germany. Until this is done we shall continue to feed the people in the Western zones as they are certainly incapable of feeding themselves for the time being.

We also must cease pretending we can finance the whole world. Everywhere one encounters the idea that Uncle Sam can provide all necessary food and clothing for everybody; that the wealth of America is unlimited. This squandering of borrowed money eventually must bankrupt private industry and the government itself. Another feature of this lending that will lead inevitably to the death of free enterprise is that the loans are made not by private banks to private banks, but by our government to other governments, which thus are forced to own or closely supervise any enterprise for which the money is used. Moreover, since they need all the dollar exchange to pay interest on this government loan, private undertakings, even if profitable, have no way of getting the money out of the country.

There are advocates who would split up Germany into two, three, or four separate states. This appears to me to be a distinct step backwards—and an unnecessary step. With the scheme suggested in the engineers' proposal and a firm determination to institute a friendly but firm control over Germany for some 25 or 30 years, she can become a useful and valuable contributor to the general improvement of the standard of living of all central Europe—assuming that free enterprise can be saved from the Russian menace. And that will go further toward permanent peace than any scheme based on restriction of production, which after all is the only source of wealth.

REFERENCE

1. Retain Germany's Peacetime Industry. *Electrical Engineering*, volume 63, November 1944, pages 393–4.



Westinghouse photo

Standing 37 feet high when completed, three single-phase transformers such as this one manufactured by the Westinghouse Electric Corporation will step up potential to as much as a half million volts for the high voltage test lines of the American Gas and Electric Service Corporation

Training in Electrical Industries

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PREDICTIONS have been made that 30,000,000 persons are to change jobs in this readjustment period immediately following the war, in the mass shift from wartime to peacetime occupations. Whatever the number, it is obvious that private industry is faced with a problem in the mass retraining of war workers for peacetime uses as serious and as urgent as that which faced the war industries in training the thousands of workers needed at all levels of skills to man the nation's war plants.

The problem of retraining large numbers of war workers for peacetime pursuits confronts many industries today. During the war when industry was faced with the reverse problem, conversion to wartime production, the Federal Government provided aid through the Engineering Science and Management War Training Program under which war plant employees might take advantage of short technical courses offered by co-operating educational institutions throughout the United States. In the hope that industries reconverting to peacetime production might profit through similar methods, this article offers a survey of the University of California's experience with the war training program.

To help the war industries meet this problem, more than 200 educational institutions throughout the United States gave special college-level courses under the Engineering Science and Management War Training Program, developed and financed by the Federal Government through the United States Office of Education. The University of California, because of its location in the nation's ranking war production area, became the largest participant in this program, enrolling more than 150,000 men and women in 4,400 courses, under the direction of Professor Morrough P. O'Brien, dean of the college of engineering at Berkeley.* The university thus gained experience which, in the light of industry's present training needs, may afford many practical suggestions to those confronted with this problem.

Approximately ten per cent of the 151,202 enrollees in war training classes were in electricity or in courses closely associated with electrical engineering. From the beginning of the electrical program, early in 1941, to its termination in June 1945, 16 full-time or part-time supervisors participated in its organization and supervision. Supervision increased with the growth of the program until the equivalent of about $4^1/_2$ full-time men was required for the peak years 1943–45. Electrical classes were organized on a state-wide basis with the greatest number being conducted in the San Francisco and Long Beach–San Pedro areas. This discussion is restricted to the electrical war training programs, designed to train or upgrade engineers, journeyman electricians, and technicians, in the various war and essential industries of California*. Emphasis is placed on shipbuilding, maintenance, construction, and operation.

The chief objective of the program was to supply sound training as a basis of attack on personnel shortages and deficiencies in war or essential industries. From the beginning, in February 1941, it was obvious that the desperately needed technically trained workers could not be produced overnight. Three major aims were practical:

1. To bring practicing engineers up to date on new developments
2. To assist engineers in changing over to electrical or radio engineering from other fields.
3. To upgrade skilled mechanics and technicians.

In general, instruction was offered on three levels:

1. Courses for skilled mechanics and technicians: These men were not always high school graduates; however, they had completed craft training, had considerable practical experience in their positions, and were potential or current supervisory personnel. Frequently they were prepared poorly in mathematics and physics so that courses were, of necessity, descriptive in nature. Thus the educational program expanded horizontally, that is, additional courses were limited to the same technical level rather than progressing in technical difficulty.

2. Courses for students having satisfactory backgrounds in mathematics and physics, such as those with junior college training: At this level the sequence of courses expanded vertically, that is, they increased in technical difficulty as do ordinary college courses.

3. Courses for practicing engineers: Successive courses progressed vertically at a much faster pace than at the two subprofessional levels.

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* See "Training for War Industries," mimeographed edition, September 1945, University of California, for comprehensive discussion of entire program.

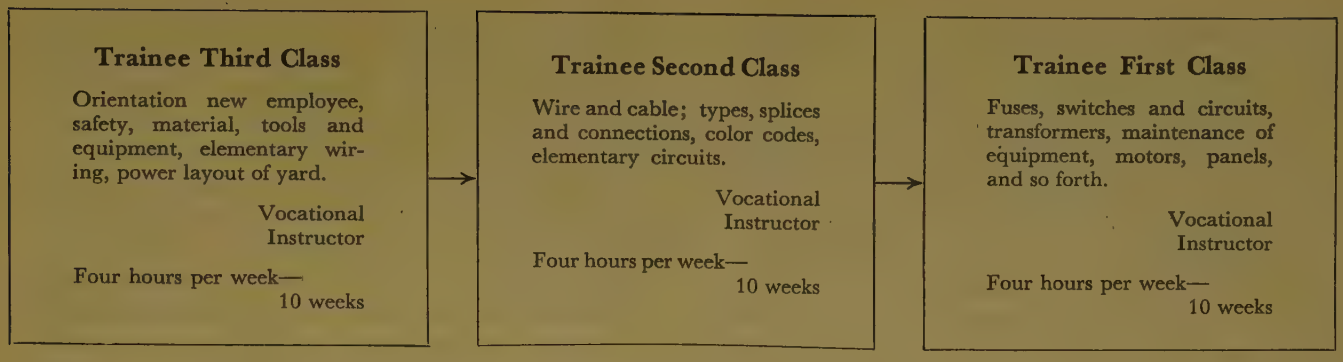


Figure 1. Suggested educational programs for shipyard trainee electricians for large and small organizations (craft training)

The total enrollment was of less significance than was the quality of the trainees and their practical opportunity to use the training to advance the war effort. Selection of trainees was made with as much care as the wartime rush would allow, and prerequisites for courses were written to screen out applicants who were not equipped for the work. For professional courses presenting subjects normally given as part of an engineering curriculum, normal academic prerequisites were used. For many low-level but badly needed courses, such as those designed to develop supervisors or technical workers, it was necessary to broaden the prerequisites to admit mature students with practical experience, otherwise the trainees of greatest potential use to industry would have been eliminated. In general, the minimum prerequisite was high school graduation or equivalent education,* or satisfactory completion of a qualifying examination in subject matter basic to the work of the course, and employ (or qualifications for employment) in a war industry.

A student was admitted to these war training courses according to an estimate of his probable success made by the supervisor and based on:

1. An analysis of the applicant's background of education and experience as shown by his application blank.
2. His score on qualifying examination covering knowledge essential to the course.
3. A personal interview when information from the first two sources was inconclusive.

No one of these three means of rating applications provided accurate measures of likely student success. An industrial training program less rushed for time well might study, with the help of a testing specialist, both vocational tests and standardized achievement tests as a means of student selection. As checked by sampling of application blanks, the average student had a formal educational background of 13.2 years (university sophomore standing) in contrast to the average schooling of 8.6 years of the adult male population.

Electrical classes generally consisted of 2 to $2^1/_2$ hours of lecture or 3 hours of laboratory and met once a week for 15 to 20 weeks. Instruction was conducted at various technical levels in electrical theory, design, operation, maintenance, and repair, and in the fields of power, radio, and industrial electronics. Public classes were conducted in war training centers such as Berkeley, San Francisco, and Long Beach, and in various highschools and junior colleges located near vital industries. The public classes were effective in training both engineers and electricians for war industries which lacked sufficient personnel to support individual classes. These classes usually were conducted at a higher technical level than the in-plant classes, many were of strictly graduate level, and advanced courses were given in communications, ultrahigh frequency phenomena, and industrial electronics. Public courses were of necessity more general than in-plant courses, and inevitably included material of secondary interest to some of the class members. As the national organization for war matured, the need for training shifted from preparation for initial employment in war production to training aimed at improving the knowledge and efficiency of employed personnel. The different needs, together with the growing recognition of the war training program by industrial management, fostered in-plant courses as an effective means of providing training in specific requirements for satisfactory performance of a department or of a group of employees within a given plant. Members of in-plant courses were a homogeneous group as far as interests and production experiences were concerned. This established effective learning situations. The instructor, after consultation with management and an inspection of the plant, knew the makeup of his class, the jobs being done by the students, and their relationship to other jobs in the plant. Thus it was possible to plan course content to achieve specific results and to avoid irrelevant material. Classes were held on company time, part time, or after work.

* Equivalent education was interpreted as completion of a substantial course of study in the field covered by the course, such as completion of correspondence or class courses conducted by an institution of recognized standing (International Correspondence Schools, various university extensions); completion of the craft training program; or recognition of accomplishment, such as holding a license (licensed marine engineer, commercial radio operator); or service in the Armed Forces with a rating or rank of commissioned, warrant, or petty officer.

Many difficulties were encountered in organizing the program. Industrial contacts already established by various university departments, notably the college of engineering and university extension, gave the program an initial point of departure. This was helpful but inadequate in a state so affected by the impact of war. Early consultation with industrial executives vital to national defense indicated little or no recognition of the need for technical training to combat personnel shortages and production problems. From the beginning a continuous and aggressive plant-by-plant canvass was carried on by the supervisors who were qualified professionally and practically to recognize production problems and training needs, and to recommend possible solutions. Helpful information on local war contracts and manpower needs was secured from chambers of commerce, manufacturing associations, engineering societies, war production councils, the War Manpower Commission, United States Employment Service, and other federal agencies. Local "men wanted" advertisements, state employment statistics, and manpower surveys were studied. Courses in technical subjects related to an industry were offered in the vicinity of the larger plants, and local facilities were established in strategic industrial areas in anticipation that technical training would gain acceptance as a means of improving production.

Theoretically, the determination of training needs should be a function of the training department of the company concerned. Unfortunately, few such departments in large war plants were close enough to all other divisions in their company to be cognizant of all training needs. Furthermore, training departments in new plants were forced by circumstances to devote most of their attention to training large numbers of employees in a few manual skills. As a result, the needs of rather small groups for specialized training often were overlooked.

The success of the program depended to a large measure on the type of instructors it was possible to recruit.

Table I. Typical 3-week lecture schedule for course given by University of California in co-operation with United States Maritime Service as part of Engineering Science and Management War Training Program

Subject	Number of Hours Per Lecture
Heavy a-c machinery	2½ (2 lectures)
Engine room electric equipment	2½ (3 lectures)
Degaussing systems	2½ (1 lecture)
Pressure reducing valves, feed pump governors, and thermostatically controlled valves	2½ (1 lecture)
High pressure steam boilers	2½ (2 lectures)
Combustion and superheat control and feedwater regulators	2½ (1 lecture)
Compressors and pumps	2½ (1 lecture)
Boiler feedwater treatment	2½ (1 lecture)
Lubrication and fuel oil	2½ (1 lecture)
Fire protection	2½ (1 lecture)
Steam turbines	2½ (2 lectures)
Refrigeration	2½ (1 lecture)
Purification of turbine oil	1¼ (1 lecture)
Steering engines	1¼ (1 lecture)

Experience proved that instructors must possess both practical and theoretical knowledge, be genuinely interested in their subject and students, and must like to teach. The pressure of expanding western industry created competition for the services of engineers and others capable of teaching technical subjects and made it generally preferable to use part-time rather than staff instructors. It was recognized early in the program that the supply of professional teachers was totally inadequate and it was necessary to obtain qualified engineers from various sources. Securing a competent staff, even on a part-time basis, was difficult and at times seemed almost impossible. Manufacturers of equipment being installed on the ships supplied men to teach courses on installation and operation. Power utility engineers discussed problems of electrical maintenance. Plant engineers discussed yard layout, maintenance, and current problems, and officers were obtained from the services to discuss equipments classified as to security.

Acknowledgment and appreciation is due the electrical manufacturers and utility companies for allowing their heavily loaded engineers to undertake the additional burden of instructing in the program. Most of the success of the electrical program can be attributed directly to this farsighted policy of co-operation.

In a program largely dependent upon industrial personnel for a teaching staff, rates of compensation must take into account the instructor's position and salary, his professional or technical education and experience, and the total amount of time he is to devote to course preparation, local travel, and classroom teaching. The civilian aspect of the war has been fought on a pay basis. Under similar conditions in the future, college-level training must meet the going wage which the instructor can earn at his profession in the community, or lower its standards by hiring men who cannot meet industrial requirements.

Aggressive publicity, both in making war industries aware of the war training program, and in the promotion of scheduled classes, played a major part in encouraging greater use of these courses. In completing arrangements for in-plant courses, the university supervisor included an offer to supply posters, individual course announcements, house organ stories, and other helpful publicity material, and also emphasized to company executives the importance of seeing that this material was distributed properly and was supplemented with promotional aids of their own.

One of the greatest obstacles at the beginning of the program was the indifference, and in some cases hostility, of management toward university sponsored training. Many felt that the workers should be forced to learn the "hard way," without the benefit of free education. Some superintendents frankly stated that they wanted their workers kept in ignorance lest they become discontented with their work, or lest they demand higher wages. However, one or two courses were usually

sufficient to establish the worth and need for training. Subsequent courses received less opposition, and, toward the end of the war, training on company time with Navy or Maritime Commission approval was exceedingly helpful.

At the beginning of the program, Washington officials of the armed services were of the opinion that the program would be of no value to military or naval establishments. However, many local civilian electrical superintendents felt quite differently. When the ponderous wheels of government finally revolved, 300 students were enrolled in electrical classes at each of two Navy yards, much to the amazement of the officials concerned. These classes should and could have begun at least three years sooner.

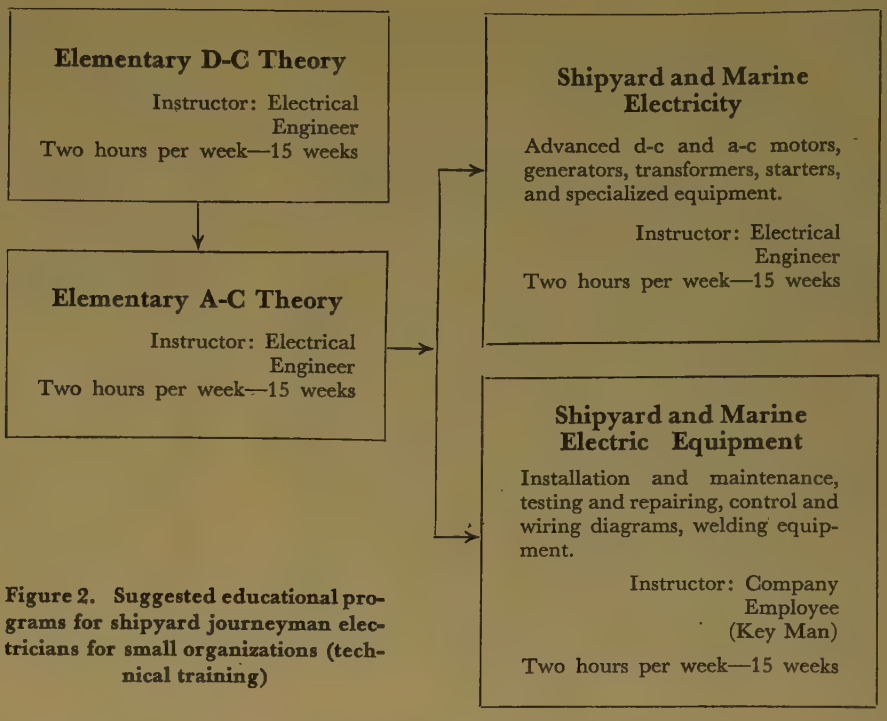


Figure 2. Suggested educational programs for shipyard journeyman electricians for small organizations (technical training)

Student response to electrical training always has been good. In fact, in many plants the class attendance has been many times original estimates. Men have shown an eagerness to acquire technical backgrounds for their vocational skills in spite of obstacles such as poor company attitude, transportation, housing, sickness, overtime, and constantly changing work schedules.

The most important factor determining the success of in-plant programs was the attitude of the electrical superintendent. In planning future programs one should plan to spend much time and effort in convincing supervisors and top management of the value and need for technical training, and the now quite generally recognized fact that technical training does *increase* production. One also should make every effort to begin large programs as early as possible, for the benefits of training often are delayed. Too often we have encountered the belated realization that, "this training is needed badly, but the course should have been given a year ago to do any good now!" Another source of friction was that one plant occasionally would find its best men stolen by a competitor and, therefore, would be reluctant to serve as a school for the industry. This circumstance can be overcome only by close co-operation between the various government agencies, labor representatives, and management, and the adoption of an overall training policy for a given industry.

It is difficult to evaluate any industrial technical training program. Ships are not launched days ahead of schedule because of one electrical class, and although technical instruction is admittedly necessary in the electrical field, any single class may add but little to the reservoir of knowledge available to a particular group. Nevertheless, technical knowledge has been the driving force behind the production miracle recently wrought, and each class contributed its increment. War training helped to meet the shortage of engineers and skilled technicians, and helped to maintain a group of adequately trained men in the electrical departments. In addition, it effected innumerable savings or innovations, some of which are mentioned later in this discussion.

Electrical training programs were conducted in 21 shipyards throughout the state of California. This included all but the smallest yards or ship repair bases. Some of the larger yards established electrical training organizations, constructed classrooms, and in one instance, equipped a modest electrical laboratory. In the majority of cases classrooms provided by the yard training departments were used. Some of the smaller yards had no training facilities, and a portable blackboard in one corner of the electric shop, or mold loft, sufficed. Most classes were conducted under very unfavorable conditions. Inexperienced instructors carried on in spite of ever-present distractions such as wide variations in attendance due to overtime, men dirty and tired from the day's work, and high noise levels. A spot check at one location indicated that an average of $19\frac{1}{2}$ steam trains passed within a few feet of the class during the two hour period. Considering the handicaps, the results are surprising indeed.

A careful study indicates high correlation between the intensity of electrical training and the success of the yards. The correlation is most apparent when one compares the success of the training with the abilities of the yards to change over from simple types of vessels to the complicated succeeding types or to repair work. Lack of space precludes detailed treatment; however,

examples cited in the following are of special interest.

Electrical training was started at Moore Dry Dock Company in August 1942, and 23 courses were completed by the early part of 1944. Top management, the training department, and the electrical department were actively co-operative, and this yard was the first to establish an adequate training program. The yard developed a home-study program for helpers and trainees which resulted in the publication of a text.[1] The war training program was integrated with the home-study program on higher technical levels for journeymen and above. The increasingly complicated vessels constructed and outfitted in this yard were handled on schedule and additional ships were outfitted here from other yards which lacked trained personnel. In the fall of 1943, this yard cut its personnel by 1/3 and was able to reduce electrical man-hours per ship by about 20 per cent. The management openly admitted that electrical training contributed largely to this outstanding accomplishment. Discussions in one class organized for engineers and foremen led to design changes which have been estimated to have resulted in the saving of over a million dollars on a 65-ship contract. Later an attempt was made to economize by employing a subcontractor. The contractor's men were not trained properly and the work had to be torn out and redone by the regular workers in the yard.

In contrast, consider one of the shipyards in Southern California. Here an unsuccessful attempt was made to prepare marine electricians for the change from Liberty to Victory ships in January 1944. Only when difficulties became unsurmountable was Engineering Science and Management War Training given a real chance. A concentrated program consisting of three two hour meetings per week on company time was begun—but this was too late to prevent serious delay in the outfitting of the first ships in a series of vitally needed naval vessels. As a result the yard failed to meet production schedules. Four hulls were towed 500 miles to the San Francisco area, and five were towed 1,000 miles to Vancouver, Wash., for outfitting. This waste of priceless time, not to mention money, could have been avoided by proper and timely training.

The most comprehensive technical program was organized at Bethlehem Steel Company, Terminal Island. The first step was a review of the plant's existing craft training and its further training needs by a plant committee made up of the assistant manager, the sales manager, management's representative, the superintendent of hull repairs, and the superintendent of machinery repairs. Careful plans for instruction and for selection of trainees were worked out with the help of the Engineering Science and Management War Training supervisor, resulting in a program which included marine electric equipment, marine piping, marine Diesel engines, steam turbines, and steam boilers and auxiliaries.

The assistant manager reviewed each qualifying examination and disqualified those who, in his opinion, would benefit least from instruction. As the program progressed, permission to take successive courses depended upon achievement in the preceding course. The students were limited to qualified men in the repair and new construction departments plus a specified number of employees from associated departments, such as drafting, testing, and purchasing. This was done so that representatives of the associated departments would understand certain engineering problems which affected their work. The instructors were selected by Engineering Science and Management War Training, and were interviewed and approved individually by the assistant manager. This program began in March 1944, and was conducted on company time.

Co-operative instruction with the armed services was another significant part of the program. The turboelectric tankers and turbogear Victory ships developed in 1943 and 1944 were designed to operate at higher temperatures and pressures than marine engineers were accustomed to handling. Furthermore, the inclusion of electric drive and electric auxiliaries proved to be formidable innovations. In order to prepare engineers to operate these ships, the United States Maritime Service established a school at Sausalito. Licensed marine engineers attended this school for three weeks during which time they were transferred to the payrolls of the United States Maritime Service. Day classes were conducted by United States Maritime Service officers and much time was spent in the partially completed hulls, studying prints and piping layouts, trial runs, and so forth. Technical lectures were given by engineers who were employed by the manufacturers supplying the steam and electric equipment being installed in the ships. This co-operation with the United States Maritime Service brought the latest and best technical information to the students and gave them a satisfactory combination of theory and practice. A second Maritime Service school was established at Richmond, and a third on the east coast. Although this third school was organized with the assistance of a former University of California Engineering Science and Management War Training supervisor, and a former officer from the United States Maritime Service school at Richmond, subsequent supervision was handled by an eastern university. The scope of subjects and number of hours devoted to each are illustrated in the typical three-week schedule shown in Table I. Classes were given at unusual hours as the result of compromise often necessary when employing practicing engineers as part-time instructors. The Sausalito and Richmond school terms subsequently were lengthened to four weeks. A total of 1,248 marine engineers attended the two schools during the period September 20, 1943, to June 30, 1945. This combination of training was considered so valuable that, with the termination of the war training program, the War Shipping Administration contracted with engi-

neering extension to continue this instruction while the shortage of marine engineers lasts.

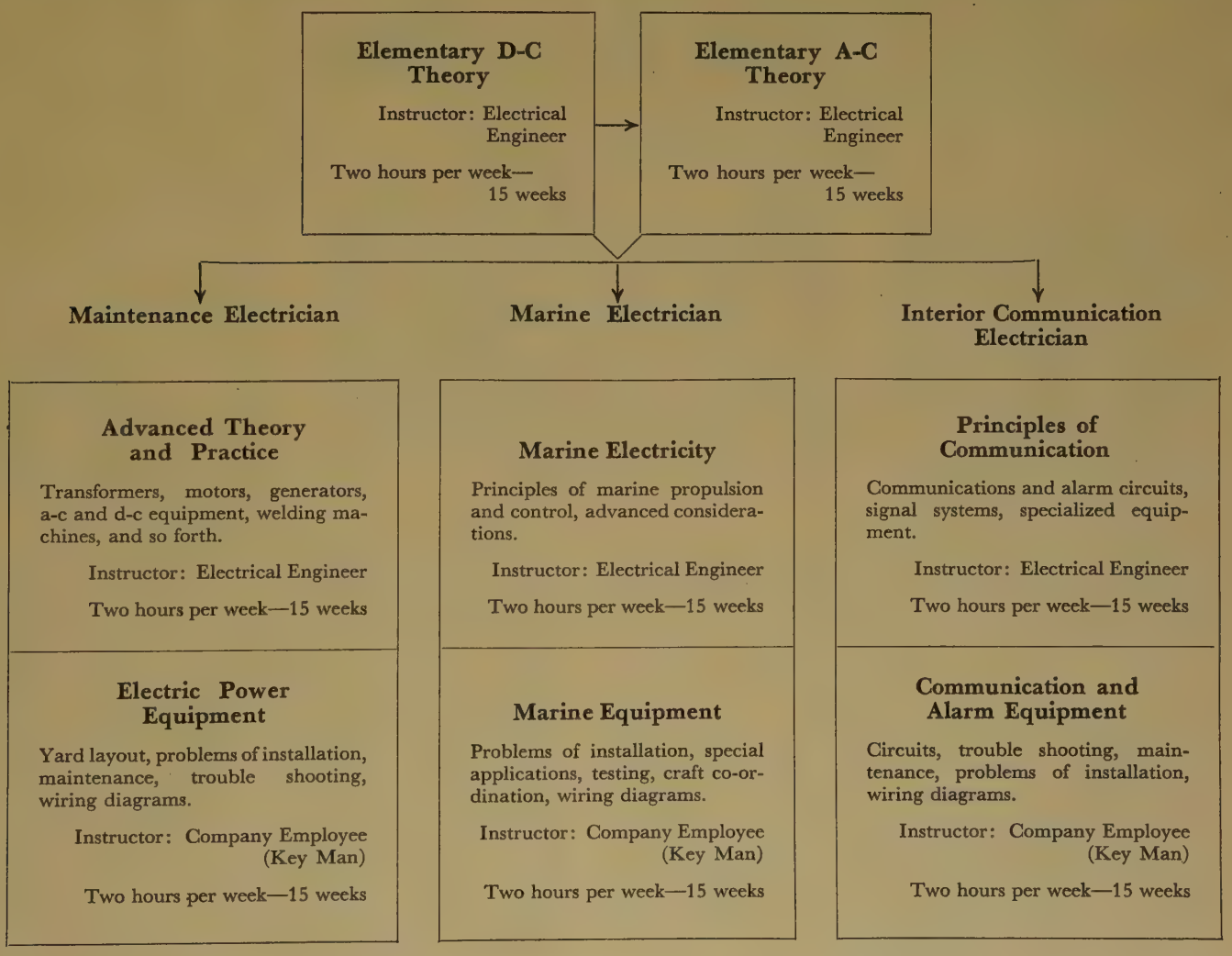
Similar co-operative instruction was provided for United States Navy officers about to be assigned to engineering positions on combat vessels at the Operational Training School, Treasure Island, and at the Naval Training Center, Terminal Island. A total of 347 officers was enrolled in these classes before they were concluded because of changes in the Pacific theater.

Co-operation with locals of the International Brotherhood of Electrical Workers proved an efficient way of training large groups of workers, especially those employed in smaller industries. The psychological reaction of students was much better than that of many in-plant courses. In these classes, as in the public classes, there was no incentive to take training in order to achieve advancement in an organization simply by having attended a course of instruction.

During the early months of war training, particularly in the Richmond area, much time and energy was lost because of the lack of co-operation and even hostility between War Production Training and Engineering Science and Management War Training. The former was set up on a "vocational" level, yet its upper limits were not defined. As a result there was much conflict over courses in electrical theory at the lower levels. A clear-cut separation should be made at the journeyman level. This separation was effected in the program as it developed, but a consecutive, integrated training pattern never evolved. As a result of consultations with electrical superintendents, training directors, instructors, and supervisors, training programs were worked out to co-ordinate effectively vocational and technical training for both large and small organizations. Although the outlines shown in Figures 1, 2, and 3 never were achieved in their entirety, they are included for future reference.

In addition to formal instruction, all classes served as a clearing house for problems arising daily in the war industries in which the students were employed. In-plant classes obviously could stress particular troubles in a particular plant, yet the public and union-sponsored courses had their share of special benefits. For example,

Figure 3. Suggested educational programs for shipyard journeyman electricians for large organizations (technical training)



conclusions reached in one public course made it possible for a Bay area engineer to fly to Southern California and activate the electronic equipment on a group of B-17s which long had been grounded. Discussions in one union-sponsored course led to the correction of resonant currents and resultant frequent faulting in a large transformer serving an arc furnace which supplied castings for two large Navy yards, and every failure required a shutdown of at least two weeks for repairs.

No university credit was given for war training courses but students successfully completing them were given "certificates of completion." Although certificates were given for satisfactory completion of individual courses, an effort was made to encourage the student to complete substantial work in the field, and rather elaborate certificates were awarded upon the completion of 125 class-hours of instruction. This usually represented completion of four courses and required approximately one two hour meeting per week for a year.

The success of the electrical program was due largely to the man-hours spent by the supervisors talking with workers and students, determining training needs, selecting capable instructors, publicizing the program, and actively supervising the organization and conduct of each course. This resulted in a relatively high cost per student hour, but was repaid well in efficiency of instruction and in respect and esteem for the program. Many executives have taken the time and effort to write letters of appreciation expressing the opinion that the program made a material contribution to the war effort.

REFERENCE

1. Practical Marine Electricity (book), S. N. LeCount, H. S. Dusenbery. The Macmillan Company, New York, N. Y., 1945.

Wire Recording

D. W. PUGSLEY
ASSOCIATE AIEE

Magnetic wire recording, which has been known since 1896, found many applications during World War II where the Armed Forces needed lightweight portable recording equipment which could operate under a wide variety of conditions. Although this method of recording has disadvantages in comparison with other more highly developed types employed today, a promising future is indicated.

ALTHOUGH perhaps new to many, wire recording is not a new art. Valdemar Poulsen, a Danish physicist, invented and demonstrated magnetic recordings on steel wire as long ago as 1896, and during the Paris Exposition of 1900 he made quite a sensation with his now famous Telegraphone.

From that day to this, there have been numerous investigators studying this type of recording with varying success. A few commercial models have been manufactured and sold in relatively small quantities at various times. However, there has been no large commercial exploitation of it in the United States as yet.

In the years just prior to World War II, the Bell Telephone Laboratories, the Western Electric Company, and the Brush Development Company were engaged in the development of this art to some degree, and during the war further impetus was added to this development. Work at the Bell Telephone Laboratories was carried out largely under the direction of Doctor C. N. Hickman and at the Brush Company under the direction of Doctor S. J. Begun. Doctor Begun also was active in this field in Europe several years before the war.

In the years just prior to the war a newcomer entered the field. Marvin Camras, a student at the Illinois Institute of Technology, became interested in the subject and built a machine of his own which embodied several of his own inventions. It worked so well that the Armour Research Foundation engaged him to work full time on his device, and gave him the necessary support. Shortly thereafter the Armed Forces became interested in the project because of their need for a recorder which would work well under battle conditions. Following this, contracts were given to several manufacturers to develop and manufacture models for various military uses. The General Electric and Brush companies, Utah Radio Products Company, J. P.

Essential substance of a conference paper presented at the AIEE winter convention, New York, N. Y., January 21–25, 1946.

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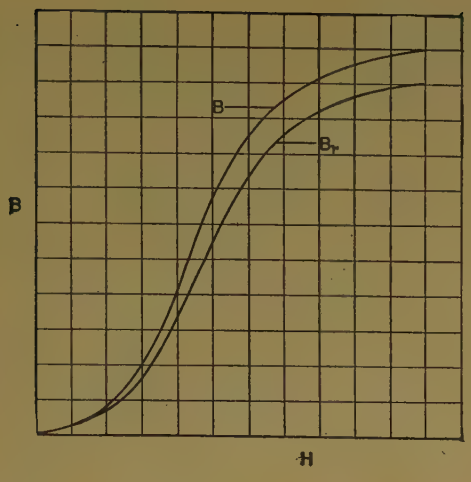


Figure 1. Typical B-H and B_r-H curve for iron

Seeburg Corporation, Radiotechnic Laboratory, and others, produced various types of wire recorders for military purposes.

So much was learned during this program about the subject that the wire type of recorder now promises to be a major competitor of other recorders in the postwar world for many applications.

One of the chief disadvantages of this recorder in the early days was the poor quality obtainable from it. However, that defect now has been overcome to the extent that quality now can be obtained which definitely is comparable, and in some respects superior, to other types of recordings. This is indicated by the fact that numerous concerns have announced that they will sell commercial models intended for home use in the postwar era.

ADVANTAGES AND DISADVANTAGES

Magnetic wire recording, as might be expected, has its own peculiar and inherent advantages and disadvantages over the more conventional types of recording. Some of these result from the fact that the mechanism of recording is magnetic phenomenon, and some from the shape and size of the medium. These advantages and disadvantages ultimately will establish wire recording in its most logical applications where it can do a better job at a lower cost. Probably at the outset, however, some applications may be exploited for which another medium is suited better, and, conversely, some of its logical applications may be overlooked.

Following are some of the more outstanding advantages and disadvantages of this type of recording. These are not listed as being peculiar only to this type as some of them are also characteristic of other methods of recording, but the combination of these items is peculiar to magnetic wire recording. Among the advantages are:

1. Long uninterrupted playing time with a relatively small record. By use of a small diameter wire an excellent space factor can be obtained. For instance, an hour's recording, with good fidelity, can be placed on a spool approximately three inches in diameter and five eighths inch thick.

2. Very simple recording procedure. This is apparent especially to those who have experimented with disk recorders which use a cutting head.

3. Medium may be used innumerable times for new recordings. Thus, when a recording has served its purpose it may be used as a new blank. It need not be thrown away.

4. Recording is erased easily if desired, thus making possible correction of mistakes or insertion of changes. The saving in money because of this feature, especially for the amateur, is apparent.

5. Large number of playbacks possible without appreciable deterioration of quality. Disk recordings have been relatively poor in this respect in the past. Wire recordings reportedly have been played hundreds of times with little deterioration.

6. Medium is spliced very simply thus making dubbing-in easily accomplished. This again is a matter which is chiefly of importance to the amateur.

7. Good frequency response. Response to 6,000 or even 10,000 cycles per second can be obtained easily with quite low wire speeds. Higher response can be obtained by simply increasing the wire speed.

8. Low noise level. Alloys such as are in process of development by the General Electric, Armour, and National Standards companies have a signal-to-noise ratio of 40 to 45 decibels. Other alloys conceivably can be developed which may do even better. (The term signal-to-noise ratio, as used here, refers to the over-all ratio between root-mean-square signal output and root-mean-square noise output of a complete machine, properly equalized, with the signal recorded at such a level that the distortion does not exceed ten per cent.)

9. Recording is relatively unaffected by vibration, shock, or position of recorder. This makes it especially valuable for use on airplanes, trains, and other vehicles.

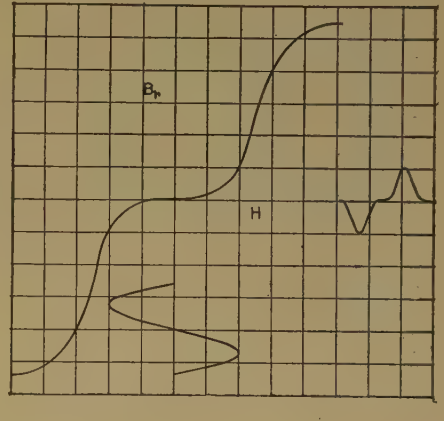


Figure 2. Distortion resulting from recording about origin

10. Portability of equipment. A complete recorder and reproducer can be made easily which occupies a relatively small volume of space and weighs only about 30 pounds.

11. Relative indestructibility of record. As it is a steel wire, the record is not damaged or destroyed as easily as some other types of records.

12. Unaffected by extremes in temperature.

Among the disadvantages are the following:

1. After recording and after each playing, the record must be rewound before being played. Rewinding time may be much faster than playing time, but it is still a factor to be considered.

2. Medium is difficult to drive. Clever design is necessary to avoid "wow," to avoid wire from becoming slack or tangling, and to avoid breakage. However, such drives can be and have been designed.

3. Medium is not as convenient to use as a disk. The incorporation of a complete magazine loading feature overcomes most of this disadvantage, but complicates the design and adds to the cost of the record.

4. A record is not reproduced easily in large quantities. The most feasible method for reproducing records in large quantity appears to be by rerecording from a master record. A substantial number of recordings can be made simultaneously by this method, and the wire speed during recording possibly can be faster than normal, thus shortening the time required. However, there is much development to be done before this method of reproduction will compare favorably with the manufacture of disk records.

5. The blank medium (before having a recording placed on it) relatively is quite expensive as compared with mediums such as disks. This cost may decrease considerably, but improvement in this direction probably will follow use of less wire per record (by using lower wire speeds) rather than reduction in cost of wire, inasmuch as drawing of fine wire is an old established art and large quantities have been drawn for other uses.

HOW IT WORKS

In Figure 1 is shown a typical *B-H* (magnetic flux density–magnetic intensity) curve for iron and also a B_r-*H* curve. The B_r-*H* curve shows the relationship between remanence and applied magnetomotive force corresponding to the *B-H* curve shown at the left of the figure. This curve normally is not shown in magnetic data because, ordinarily, the relationship between flux remaining after removal of the magnetizing force and the magnetizing force itself is not of much value to the designer. However, this factor is the most important factor for magnetic recording as if there were no remanence obviously there would be no recording.

A recording could be made using such a characteristic by causing *H* to vary according to an impressed sound wave on a continuous magnetic medium being drawn rapidly past the source of magnetomotive force. This would leave the medium magnetized along its length with each increment having a value of B_r corresponding to the applied *H* at the instant that increment was passing through the field. However, the recording would be very distorted because of the radical curvature of the B_r-*H* curve as it passes through the origin (see Figure 2).

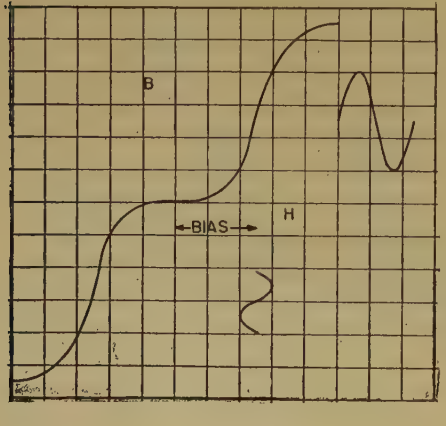


Figure 3. Distortion reduced by superposition of constant biasing field

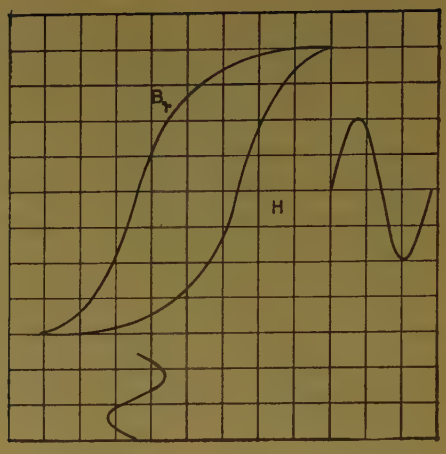


Figure 4. Method to increase dynamic range

One solution is to place a d-c biasing field on the medium prior to recording which then causes the recording to take place on the straight-line portion of the B_r-*H* curve as shown in Figure 3.

A better method, resulting in a greater dynamic range, is first to saturate the wire and then to magnetize it in the opposite direction before recording. This method is shown in Figure 4.

The latter method is the one which has been used in the past by most investigators. However, the method used by Camras in his machine, and the method which is used most extensively today, is to use no d-c bias, but instead to superimpose a supersonic signal at a frequency of 30 to 50 kc on the medium simultaneously with the signal to be recorded. By adjusting the various parameters to their proper value, an effective B_r-*H* curve (Figure 5) can be obtained. Thus recordings with low distortion are possible. The exact method by which the supersonic bias straightens out the B_r-*H* curve will not be explained in this article, but it does so effectively as shown by Figure 5 which is a curve derived from experimentally obtained data.

Figure 6 illustrates a block diagram of a complete wire recorder. As can be seen from the diagram, the signal from the microphone is amplified and applied to the recording head, which is one form of an electromagnet. Simultaneously, the supersonic frequency also is applied. On playback the magnetized medium is run through the same recording head, which now acts as a pickup coil. The voltage induced is amplified by the same amplifier and reproduced in the loudspeaker.

The erase coil is also in evidence. It is located just before the recording head and is energized only during recording. This coil is energized with the same supersonic oscillator used for recording. The erasing simply

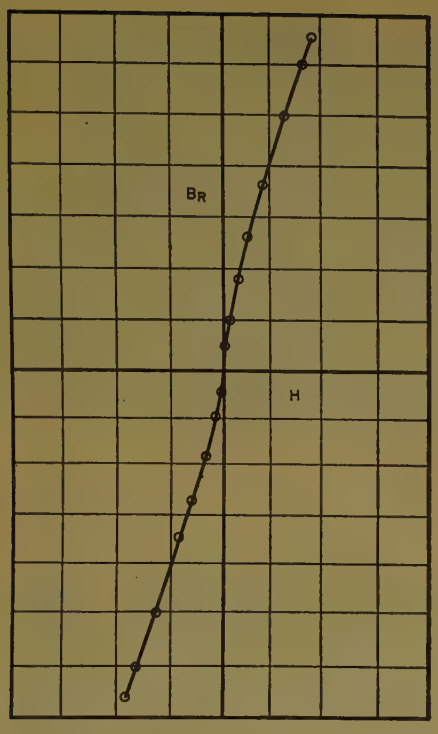


Figure 5. Effective B_r–H curve using supersonic bias

consists of demagnetization by means of the high-frequency a-c field.

Wire usually is magnetized longitudinally. This magnetization is represented pictorially in Figure 7, which also shows how the flux from the recording head enters the wire. The small air gap shown forces the flux upwards from the laminations and longitudinally through the wire. Thus, after magnetization, the wire consists of a series of alternate poles, the spacing of the poles depending on the frequency recorded and the speed of the wire. For a given wire speed there are two main factors limiting the highest frequency that can be recorded. One of these is self-demagnetization of the wire and the other is the aperture effect of the gap. Self-demagnetization is a function of the wire diameter, while the aperture effect naturally is a function of the gap width. Machines produced during World War II commonly used wire of 0.004-inch or 0.006-inch diameter and gaps of 0.002 inch to 0.004 inch, with wire speeds varying from three to six feet per second.

USES DURING THE WAR

Wire recording had almost what might be termed a rebirth during the war. The Armed Forces desperately needed recorders which would operate satisfactorily on airplanes, on battleships, in jeeps and trucks, and in similar places. Wire recorders met the requirements with marked success. Even war correspondents carried special portable models to the front lines and secured on-the-spot recordings of actual battles. Most people, often not realizing what it was, undoubtedly have heard many recordings over the radio which were taken on wire in actual combat. There also have been numerous other military instances for the use of wire recording.

QUALITY OBTAINABLE FROM WAR MODELS

Several different models were used during the war, but in practically all cases the primary intended usage was for recording of speech. Nearly all these recorders, therefore, were designed specifically for speech, and so in general were not entirely satisfactory for music. The frequency range was restricted, and tolerances were not held close enough to reduce "wow" to satisfactory music levels. A typical frequency response curve is shown in Figure 8 for a wartime recorder. This curve is for a wire speed of six feet per second. A more restricted response is obtained at a wire speed of three feet per second. Most of these recorders had about this frequency response, although one model, designed and produced by the Brush Company for higher fidelity, had the response shown in Figure 9. The average dynamic range of these machines was about 35 decibels which is comparable to average prewar disk recordings. The higher fidelity machine had about 40 decibels. "Wow" was held to a point where it was not at all noticeable on speech, but on many machines would be objectionable on music.

Figure 10 shows various wire recorders built during the war period. These do not represent all the models built, nor all the concerns building them, but do show a typical cross section.

QUALITY POSSIBLE TO OBTAIN

Postwar commercial wire recorders will be much different than wartime models. For one thing the quality will be much better, and the cost undoubtedly will be much lower. One significant improvement made recently was the development of much superior alloys for the recording medium. By the use of these new alloys, satisfactory frequency response can be obtained at wire speeds as low as two feet per second, and, if still better response is desired, it is necessary only

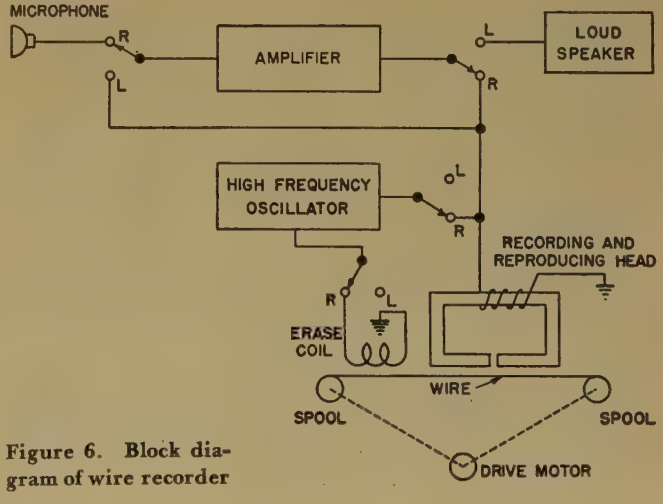


Figure 6. Block diagram of wire recorder

to pull the wire a little faster. These new alloys also have a good dynamic range (about 40 to 45 decibels) and distortion can be held down, on the average, to about three to four per cent total harmonic distortion. Using this wire at a speed of two feet per second, an hour's recording can be contained on a spool which is but three inches in diameter and five eighths of an inch thick.

In all fairness it should be pointed out that as yet these new alloys have not been produced in production quantities, the data having been taken on sample lots. However, there seems to be no fundamental reason why this type of wire cannot be produced on a large scale once the proper controls have been established in the factory.

"Wow" is a function of excellence of design and maintenance of tolerances during manufacturing, and there

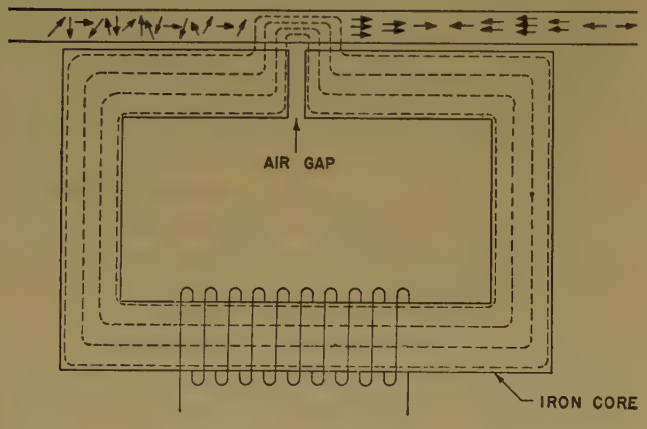


Figure 7. Recording

is no reason to suppose that good commercial models now under development by several companies will have more than one half of one per cent of "wow."

STANDARDIZATION

It seems that the stage practically is set for the commercial introduction of wire recorders in large quantities. Not all factors have been reduced to quantity production as yet, one of the notable exceptions being the new wire alloy, but this certainly should come soon. Another item yet to be settled is industry standards, but this also is progressing, at least for certain applications, and probably will not be a limiting factor.

Two groups currently are working on such a standardization program; a committee formed among the Armour licensees, and a committee on magnetic recording working under the sponsorship of the Radio Manufacturers Association. As some individuals are members of both committees, it is probable that there will not be two conflicting sets of standards evolved. Items on which standardization is needed include wire dimensions, wire

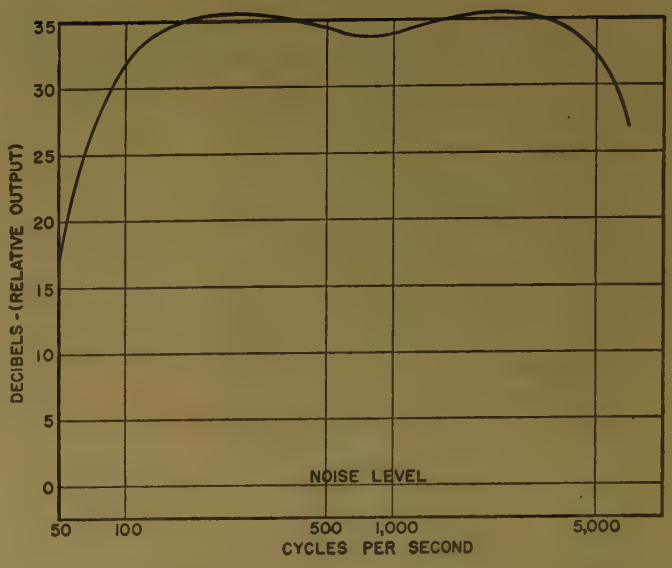


Figure 8. Frequency response curve

speed, size and shape of spool, and magnetic characteristics of wire.

Further information on quality may be found in an article by L. C. Holmes and D. L. Clarke (*Electronics*, July 1945). These men have investigated, among other things, distortion in magnetic recording by intermodulation methods, magnetic properties of recording media, proper equalization for highest signal-to-noise ratio, effect of speed of the medium, and erasing means for media with high coercivities.

POSSIBLE FUTURE USES

It should be noted that possible future uses are referred to, and not just future uses. Very likely some of the possible applications enumerated will prove to be noncompetitive with other methods of recording, and, on the other hand, probably other eventual applications are not listed.

1. Home recording. The extreme simplicity of recording, plus the ability to reuse the records, makes wire recording ideal for the amateur who likes to make his own recordings, record weddings, historical talks or events, and so forth. The small size

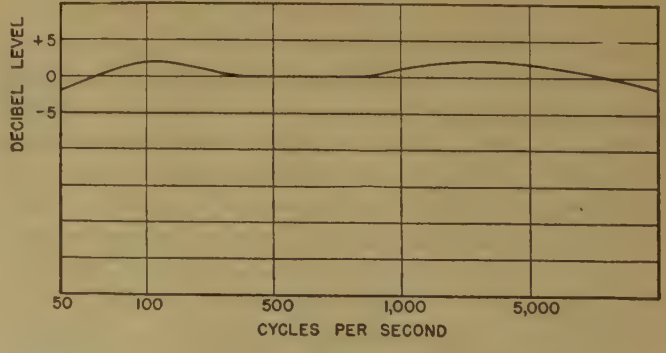
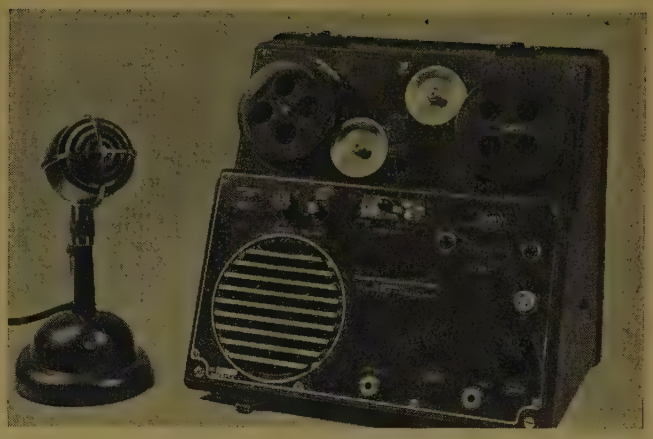


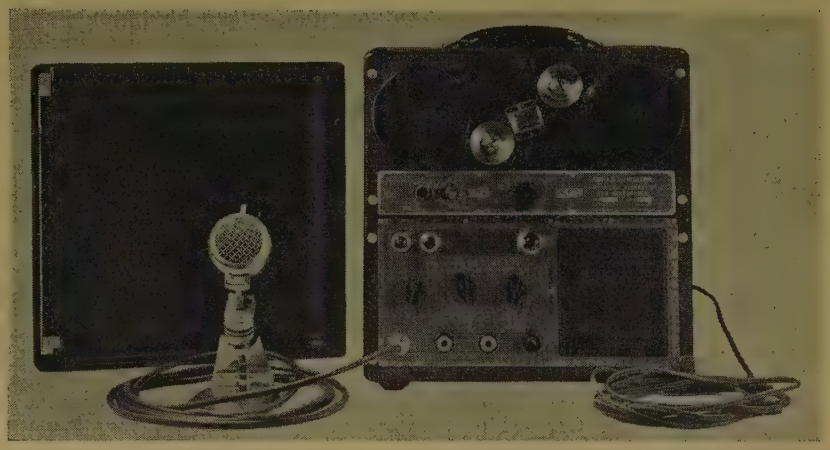
Figure 9. Over-all frequency response of wide range magnetic recorder

A—Radiotechnic Laboratory model 22



B—Armour model 50

C—Radiotechnic Laboratory model 55



D—General Electric model 51

Figure 10. Types of wire recorders

and portability of the equipment are also important considerations in this application.

2. Broadcast station usage. The fact that radiobroadcasting stations have a definite need for such a recorder is evidenced by the fact that many of them already have bought, and are using, wartime models, even though their use is very limited inasmuch as they were not designed for such application.

3. Over-the-counter records. Considerable thought and effort even now is being put forth to develop this business to the point where records on wire can be bought and sold as universally as disk records are now. It would appear that this application is somewhat further in the future than some of the others because of its many phases, but considerable effort is being expended on it.

4. Commercial and public announcements. Investigations have been, and are being, made to exploit the advantages of repetitive announcements in stores, parks, streets, and other places where people gather.

5. Pocket recorders. Very small pocket recorders can be made for recording interviews and the like. The Federal Bureau of Investigation may find such a device useful. Concerns engaged in making surveys also are looking into this possibility.

6. Record players on vehicles. Records on wire make possible the use of record players on airplanes, cars, trains, boats, and so forth. This may prove to be a fruitful field.

7. Automatic recording. Automatic recording of items such as court proceedings, telephone conversations, instructions to and from aircraft, freight car and other traffic records, is accomplished easily.

8. Juke boxes. It is conceivable that this problem might be solved better, or more economically, by the use of wire rather than disks.

9. Industrial uses. There are a multitude of industrial needs, including recording of stresses, that may prove to be met best by wire. Recorders even now are being used in such applications.

10. Educational uses. Machines may be used in schools and in homes for teaching music, dancing, language, presenting talks by famous persons, and so forth. This field is very important.

11. Teaching and amusing the blind and sick. The possibilities here are most intriguing.

These are only a few of the many applications that already have been suggested. Others undoubtedly will occur to each of you.

From all indications, it appears that Poulsen's Telegraphone is about to come into its own at last. The next few years well may see this new industry assume a prominent position in the recording field.

The Engineer and Management

LEE H. HILL
FELLOW AIEE

The engineer's relationship with management may be considered from three angles: the engineer as an employee of management, the engineer as an engineer, and the engineer as a candidate for managerial positions. However, as he moves further and further away from his slide rule up into the managerial brackets, he frequently finds that he is ill-equipped to handle the personal elements which enter into an executive position. Perhaps the solution is the inclusion of more of the so-called "cultural" and "human relations" subjects in engineering education.

EMOTIONALLY, the engineer is a human being much the same as other employees in the plant. Management's attitude toward the engineer should be based on the fact that the engineer is a person, not an engineer as such; and all the principles which have become commonplace in discussions of employer-employee relations apply to the engineer as well as to the lathe hand. The engineer dislikes unfair treatment from his superior as much as the lathe hand does; he is as little fond of being reprimanded in public as any other employee. He wants a pat on the back when he has done a good job, and he wants advancement to be on a merit basis, independent of favoritism. The engineer, however, may have a more pronounced sense of dignity and of the significance of his work.

The greatest opportunity for improvement in industrial organizations today lies in the field of improved employer-employee relations. Many employers, however, confuse employer-employee relations with union relations, which are only one narrow phase of the broader problem. They often fail to recognize the employee problem until the union knocks on the door. Then they sometimes become quite vocal about their "ungrateful" employees, and devote their entire attention to union problems, continuing to ignore the employee problem which had been present all the time, and which caused the employees to turn to a union. A case in point is that of foremen's unions. If the history of the foremen's union movement is traced, it will be found that an employee problem existed among foremen long before the foremen turned to unions in an attempt to force higher management to give them an adequate hearing.

RELATION TO MANAGEMENT

The engineer's relation to management is somewhat similar to that of the foreman, although the engineer is, if anything, even closer to management. But it sometimes seems that the higher up in the organization an employee may be, the less some managements recognize his desire to be recognized as an individual.

The only real solution to the union problem is to solve the employee relations problem, and employers, must recognize that fact. Such good employer-employee relations must be developed that the union, if there is one, must remain reasonable or lose the support of the employees themselves. Employees will support a union, no matter how unreasonable it is, as a counter-irritant to management if they feel that management itself is unreasonable.

This does not mean that the mere existence of an engineers' union, or a foremen's union, or any other union in a plant, is evidence of unsatisfactory employee relations. With a strong labor movement, the employees may organize even where relations are good. But, by and large, taking the country as a whole and industry as a whole, unionization never would have gained the ground it has if industry had not left the door wide open—Wagner Act or no Wagner Act.

The door may be opened to unionization by such a simple thing as failure to provide means by which the employee can get attention for his gripes. In the National War Labor Board panel hearings on foremen's unionization, a point emphasized by the union was that there was no grievance machinery, no way in which a foreman could talk over his difficulties with his employer. A simple enough problem, is it not? But all these employee relations problems are fundamentally simple. The road to good employee relations is really nothing more than the road marked "Good Management."

Good management treats people as individuals. It does not, discharge an employee for example, who has been with the company for 30 years because he is old and has passed the peak of usefulness. It finds some other way of taking care of him. But 30-year men still are being discharged unjustly in the United States, and the sad part of it is that many in management see nothing wrong with such actions. Unfortunately those who are

Essential substance of an address presented before a meeting of the AIEE Chicago Section, October 4, 1945, and published in the *Bridge* of Eta Kappa Nu, March 1946.

Lee H. Hill is publisher, *Electrical World* and *Electrical Contracting*, McGraw-Hill Publishing Company, Inc., New York, N. Y.

suffering from bad employee relations frequently think they are doing everything possible for their employees, and that all the trouble occurs merely because the employees are unappreciative.

If management throughout the United States would spend on its employee problem (not the union problem) just five per cent of the time it spends on production and finance, there would be fewer serious employee problems in the country. That means, of course, an effective five per cent. There is no need for more paternalism—buying turkeys for employees and things of that sort, which some people seem to think are the heart of employee relations. The employee is "ungrateful" for paternalism as well he may be, because he does not want it. What he wants is fairness and consideration, a chance to feel that management considers him important. And he wants an opportunity to advance if he has the ability to do so.

EMPLOYEE CAPABILITIES

In the case of the engineer, management has been particularly remiss in providing for advancement. Young college graduates are taken, because they can be hired for $150 a month, and are put on jobs which clerks could do, with no provision for advancement as they gain experience.

Recently I revisited a company after a lapse of five years. Except for the tinges of gray in the hair of some of the men, it seemed that I had been away hardly a month. Everybody had the same job he had held five years before.

I am sure that the man at the reception desk—a man 40 years of age who did nothing but announce callers—was not being used at his highest skill. True, he was not an engineer, but he had a personality which qualified him for something better, possibly as a salesman. It had not occurred to anyone, apparently, to help him out of his rut. Then there was the third assistant engineer, a college graduate. "I've been here for 15 years now," he said, "and I have the same job I had when I came."

Of course, these men could, and probably should, have quit. But the employer, if he wants good employee relations, never should make this necessary. If he hires these men he should find a way to develop them to their maximum capabilities. No man can be happy on his job unless he feels that he is being used at his highest skill. Any less significant work spells frustration.

Along with better opportunities for the engineering group, there is a need for more exact placement; and for that more accurate job descriptions are a necessity. Accurate job descriptions made it possible for one large manufacturing company to hire men who had failed in engineering school after the first or second year for positions which ordinarily would have appeared to require graduate engineers. The men with a year or two of training, it was discovered, were perfectly capable of handling work which required a smattering of engineering knowledge. What is more, they were satisfied with positions where graduate engineers could not have been satisfied for very long. In terms of human values, a man of active intelligence tied to a monotonously repetitive job is likely to be much more dissatisfied than an unqualified man on a difficult job.

In addition, job descriptions form the basis of a proper rate structure, and a poorly designed rate structure is one of the great sources of employee dissatisfaction. Even more important than the general level of rates are the relative rates within the structures. Conditions can be reasonably satisfactory where rates are low if individuals are classified properly with respect to each other, but there can be great dissatisfaction even with high rates, where individual salaries do not bear a proper relationship. The rates must be aligned in such a way that no one can say justifiably, "I have a more important job than so-and-so but he is paid more money than I."

Lately there has been a great deal of discussion about whether engineers are part of management or not. Actually, of course, they generally are, or should be. However, sometimes they are not treated so, just as foremen frequently are not. Whether they are or not, the National Labor Relations Board long since has decided that they come under the provisions of the Wagner Act. Whether or not the employer wants his engineers to organize, the most constructive approach is to build sound employee relations so that his engineers feel no need of organization.

Of course, from the viewpoint of the engineers themselves, another question arises: Should they organize as a matter of self-protection? Will it be to their advantage?

Engineers, by the very nature of their work, must operate on the basis of individual merit, and certainly there is nothing in union theory that recognizes individual merit. If engineers are tempted to bargain collectively they are bound to lose an important element of their professional status. As a professional man, the engineer should be able to accomplish more by individual bargaining, because collective bargaining tends to reduce everyone to the average. Collective bargaining frequently is involved with questions of *average* wage and *minimum* wage; with little concern for recognition of unusual merit or ability. Those who are below average benefit, of course, but what engineer is willing to put himself in that category? If he is, he is probably in the wrong field.

Even if the engineers themselves do not want to organize, there is the possibility that they may be included within the scope of the production workers' union. This could occur if the National Labor Relations Board designates the entire plant as the voting unit. As engineers are a comparatively small group numerically, they easily could be outvoted, and the productive

workers' union might become the collective bargaining agent for their group.

The best way to avoid such a situation is for the engineers to request that they be excluded from the collective bargaining unit of production employees, because of the absence of "mutuality of interest." The National Labor Relations Board usually would recognize such a request under the so-called "Globe Doctrine." The production workers' union probably would not be too interested in the engineers' affairs, as they normally constitute only a small proportion of the membership. If excluded from the production workers' unit, the engineers either can form their own collective bargaining agency, or continue to discuss their problems individually with their superiors. Only in a closed shop or in a union shop in a collective bargaining unit including the engineers, are the engineers forced to belong to the union in order to keep their jobs. An engineer in that position no doubt would become active in the union, and attempt to see that the viewpoint of his group received consideration.

THE ENGINEER AS AN ENGINEER

As for the engineer as engineer, the technical training given is, in general, excellent. As Dean Kimball of Cornell University used to say: "The average engineer who gets out of our engineering schools can figure out most any kind of a problem and be pretty sure of the answer, except possibly where the decimal point is." In dealing with the problems that can be solved on a slide rule, the engineer is, for the most part, entirely competent; but his training has been a narrow one, and that fact has handicapped him in some of the broader aspects of his work.

Doctor G. F. Kuder, who has done a great deal with interest tests, finds that engineers tend to score high in interest in mechanical and scientific fields, and very low in those involving persuasive tendencies and interest in social service. This is to be expected in view of the fact that engineering training, particularly during the last 20 years, has emphasized technical knowledge at the expense of other qualities. One of the main reasons manufacturers have developed graduate training courses has been that the young engineering graduate has had many rough corners to knock off and has needed to become accustomed to rubbing shoulders with other people.

The outstanding cause, in my opinion, is the failure of the engineering schools to provide training in human relations. Not only by taste, but by training, the engineer usually is rather on the introvert side. He tends to be satisfied to retire from the public eye and concentrate on physical things, rather than on the human beings about him. Generally he dislikes a sales job, and it is amazing what he sometimes does in the way of human relations. The average engineering manager often has trouble with his men because he knows how to handle only the mechanical aspects of his work; nothing in his training has fitted him for the handling of men.

One large manufacturer used to tell young engineering graduates attending his training course: "We know you won't like some of the things we are going to give you in this course. You won't like it because you are engineers. But we are engineers too, and we have gone through it. We know you don't know how to talk, how to persuade anybody to do anything, and so we're going, first of all, to give you a course in public speaking." At that the students would groan.

"Then," the leaders of the program would say, "we're going to teach you how to write." More groans.

"Then," continuing, "we're going to give you a basic course in selling."

"But," the students always protested, "We don't have to sell. We're going to be engineers."

It would be pointed out to them that an engineer needs to know how to sell his designs and his ideas to his own superiors if to no others, that he even has to sell the shop people if he wants them to work with him wholeheartedly and produce the best results and eventually the students would become convinced that there might be something to the program.

During a period of years as an engineering manager, I have observed that many engineers are not as commercially minded as they should be. Design engineers frequently are interested more in making a theoretically perfect design than they are in producing something that will sell at a profit.

It was B. G. Lamme who said, "The test of a good engineer is whether or not he can drop the subject when he gets a design that is good enough." And everyone has seen engineers who are unable to do just that. They want perfection, even if the last ounce of excellence costs ten per cent and is not worth five cents more.

Another quality which seems to be lacking among our engineers, and which may be even more difficult to develop, is the ability to state problems. Most engineers can solve a problem if it is stated for them, but they cannot seem to isolate the problem themselves. The employer has to state the problem for them, which means that they are a good deal less valuable to him than they could be. In many cases, once the problem itself is clear, the solution is apparent, or at least easily obtainable through ordinary engineering techniques.

As has been indicated, some of these gaps in the engineers' background are filled in with postgraduate courses given by industry. However, the colleges should do more of that work. They should be able to do it more thoroughly than industry can; and, as a matter of fact, some of them are beginning to accept responsibility for it. Cornell University, for example, just has added another year to its engineering course, 20 per cent of the subjects to be so-called "cultural" subjects—such as English, public speaking, economics, and business law. Engineers need these subjects, and they need also

some knowledge of accounting principles, of executive techniques, and of the fundamental principles of handling people.*

ENGINEERS AS MANAGEMENT

Finally, there is the last phase of the subject, engineers as candidates for managerial positions. Engineering training is, in my opinion, the best preparation that we have today for managerial work, particularly in fields like manufacturing, utility operation, and others of a comparatively technical nature. However, the gaps in that training which handicap the engineer in his job as an engineer are doubly hampering to him in a managerial position.

The more the job becomes one requiring executive ability, the less there is need of a slide rule. The more general the problems become, the more what is going on in the world has a bearing on the decisions. The head of a company is concerned with labor problems, the tariff, the Export-Import Bank—basic questions much broader than any covered in ordinary engineering courses. Thus, it seems to me, we could broaden appreciably the training in the case of the engineers to be developed for management positions. Here again much more emphasis on the human element is needed. Executive decisions today must be based on more than pure logic, for it is often pure emotion which determines the effect of a decision on employees.

EMPLOYEE REACTION

As an illustration of how deficient the engineer may be in this respect a recent case may be cited. Some executives were discussing the employee dissatisfaction in their plant. (It is not unionized—yet.)

The manager of the company remarked, "You know, I cannot understand these employees. It seems that the more you do for them, the more dissatisfaction you create. We instituted a pension plan for the employees that entails absolutely no cost to them and yet they are dissatisfied."

"What kind of a plan is it?" I asked.

"Well, employees earning more than $5,000 receive ten per cent of their monthly salary as a monthly pension after they reach the age of 65."

"What about those earning under $5,000?"

"They receive five per cent."

"Do I understand you correctly? Those earning over $5000 get a larger percentage than those under $5,000?"

"Yes."

"Are you surprised that you have dissatisfaction?"

"Well," he said, "it doesn't cost them anything; we give it to them."

The reaction of the employees easily can be imagined. Many of them were threatening to quit the company, would have done so, in fact, if the plant had not been in an isolated spot where other jobs were not obtainable.

It is incidents such as this, elementary things, which can play havoc with human relations. Probably even pure logic should have enabled management to forecast the employee reaction in that case, but the executives went blithely on their way, spending something like a million dollars to establish the plan. The money, of course, was thrown out the window, so far as developing good employee relations was concerned.

I believe that there is a great future ahead for engineers, if the gaps in engineering education and training can be filled in and they learn to handle the human aspects of their jobs as skillfully as they handle the technical phases. Industry is entering a new period, a period in which human problems are going to be even more important than technical problems. "Handling labor relations" is merely calling in the fire department. What is needed is fire prevention; employer-employee relations must be handled in such a way that there is no need for some outside organization to come in and speak for the employees. If engineers are going to take their place in a broader field, they must learn to recognize the human relations aspects of management, instead of leaving that important phase to some other professional group.

* See *Mechanical Engineering*, May, June, and July 1944, for a series of articles by W. J. King on the nontechnical knowledge needed by engineers.

Electrical Experiments in Germany

According to a recent report published by the British Intelligence Objectives Subcommittee, 550 yards of experimental 400-kv a-c line had been constructed in order to study corona loss in connection with a proposed 480-mile transmission of 600,000 kva from the Alps to Cologne. Tests showed that an arrangement of four conductors in parallel for each phase with 10-inch spacing between the steel-cored aluminium conductors would provide the maximum current-carrying capacity with the minimum of corona loss. Single-phase transformers with a 400-kv bushing out of one end and a 220-kv bushing for connection to a Petersen coil at the other, with lower voltage bushings at both ends, were to have been used. The air-blast circuit-breakers to be installed, rated at 1,000 amperes and 6,500 megavolt-amperes interrupting capacity, had 14 breaks in series with capacitors for promoting equal voltage distribution between breaks.

Experiments also were performed with d-c transmission with the ultimate idea of obtaining power from Norway and further supplies from the Alps. Tests were successful enough to warrant planning transmission of 160,000 kw by means of two 400-kv d-c lines from a station on the Elbe to the Marienfeld station in Berlin, 100 miles away.

Conservation in the Power Industry

N. E. FUNK
FELLOW AIEE

In the score of years since 1925, the expansion of the electric utility industry has been accompanied by deliberate and sustained reductions in fuel used and in the amounts of materials required to manufacture its equipment. Efficiency of operation with higher temperatures and greater pressures has provided the first saving, and improvement in design and interconnection of systems, the second. However, the author adds, the fuel economy curve is flattening out, and the time is ripe for a new point of attack of the problem.

THOUGH THIS article has been confined chiefly to power generation, it should be stated at the outset that all phases of the power industry have contributed to the conservation of natural resources. The privately owned utilities over a long period of time have met the combined challenges of competition, restrictive legislation, and, of late, the common woes of the war years, and have been able continually to increase their efficiency of production.

The accomplishments throughout the industry over the past two decades, resulting in conservation of fuels and of other essential materials, have been made possible by a number of basic developments, namely:

1. Greatly improved efficiency in steam power plants.
2. Rehabilitation of existing stations and equipment.
3. Interconnection of large systems.
4. Installation of hydroelectric plants where they were justified economically.

Statistics, as such, can be dry and burdensome, but a few rounded-out figures, can be used to span the attainments of the industry over the period to be considered.

At the end of 1925, the total installed generating capacity in the United States for public supply amounted to 23,000,000 kw, with an output in that year of 65,000,000,000 kilowatt-hours. Of the latter, about 22,000,000,000 kilowatt-hours (34 per cent) were generated by water power. At the beginning of 1945, the generating capacity exceeded 50,000,000 kw, with a yearly output during 1944 of 230,000,000,000 kilowatt-hours. Of the 1944 output, about 74,000,000,000 kilowatt-hours (32 per cent) were produced by hydraulic power. Distribution of the installed capacity of 50,000,000 kw showed less than 20 per cent being operated and controlled by the various government agencies, most of which was in hydraulic plants.

In 1925 a national average of 2.1 pounds of coal was required to produce a kilowatt-hour of electricity in steam generating power plants. For the year 1944 this national average had been reduced to 1.3 pounds per kilowatt-hour, and there were numerous plants built in the last decade which were producing a kilowatt-hour for less than a pound of coal—some even as low as 0.85 pound. The averages reflect the equivalent in coal, in coke, fuel oils, and gas where such fuels were utilized. Expressing this saving in another manner: it required 62 per cent more fuel to produce a kilowatt-hour of electric energy in 1925, than it did in 1944. Further, had the energy produced by steam power in 1944 been made at the coal rate of 1925, there would have been an increase in the amount of fuel burned of more than 62,000,000 tons. This information presents the picture of the size, growth, and improved fuel economy of the electrical utility industry.

Developments in power plant equipment and improvements in performance have been due to the co-operative efforts of equipment manufacturers and the engineers of the operating companies. The ever-increasing demands of the utility companies' engineers and operators for greater reliability, increased capacity, and improved performance arise from the knowledge gained through past performance of equipment tested in the laboratory of actual operating experience. Many improvements have come directly in this way, and the engineers of operating properties have had a major part in their development.

Special joint research programs between utility companies and manufacturers have been conducted from time to time under actual operating conditions in the utilities' plants, at a material saving of time and money. For example, where large quantities of high-pressure high-temperature steam are necessary to the experiments, the utility can provide the live steam and absorb the exhaust steam and the electric energy produced. Such research is encouraged and proves of mutual benefit to the utility, the manufacturer, and the customers of both. An illustration of such joint research is the tests carried out on a special superposed turbine built by Westinghouse Electric Corporation and installed at

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Essential substance of an address presented at the general luncheon held May 2, 1946, during the 34th annual meeting of the Chamber of Commerce of the United States in Atlantic City, N. J. The subject for the luncheon was "Our 'Vanishing' Natural Resources."

N. E. Funk, vice-president of the Philadelphia Electric Company, Philadelphia, Pa., is a junior past president of AIEE.

Schuylkill station of the Philadelphia Electric Company. The unit, of 10,000-kw capacity with a full-size impulse wheel, operating at 1,250 pounds pressure and 900 degrees Fahrenheit, was utilized for study of factors affecting performance of impulse blading under actual plant conditions. The results of these tests produced new information which already has been utilized in eliminating some difficulties with the blading of existing machines, and which, without question, has resulted in the ability to improve future designs.

No small part has been played by the work of committees of the national engineering societies, including the AIEE, the American Society of Mechanical Engineers, the American Society for Testing Materials, the American Standards Association; and of outstanding industry committees, namely, the electrical equipment, hydraulic power, and prime movers committees of the old National Electric Light Association, and, in more recent years, of the Edison Electric Institute and the committee on power generation of the Association of Edison Illuminating Companies. Through reports of operating performance and round table discussions between committee members and manufacturers, the time for proving new designs has been reduced considerably, and has increased greatly the rate at which each new step forward can be taken with confidence.

The accomplishments throughout the industry in the past two decades toward conservation of fuel and other materials have been made possible by a number of particularly outstanding basic developments. Of primary importance has been the ability to increase steam pressures and temperatures markedly and to increase the speed of rotating machinery. The first has been responsible for the improvement in efficiency, and both have reduced greatly the weight of materials required. Both also have necessitated a tremendous improvement in the quality of material used.

In 1925 thought had been given to increasing turbine speeds with greater unit outputs per pound of material, and one installation had gone into service at 1,200 pounds per square inch pressure and a temperature of 700 degrees Fahrenheit, but, because of lack of experience with these steam conditions, pressure of 400 pounds per square inch and temperatures of 700 degrees Fahrenheit were considered more desirable at the time.

METALLURGICAL RESEARCH

Since that time, continued studies of performance of metals for use at higher steam temperatures and pressures have produced alloy materials suitable for temperatures from 900 to 950 degrees Fahrenheit. In fact, a few installations have been designed for operating temperatures of 1,000 to 1,050 degrees Fahrenheit. One unit is operating at a nominal pressure of 2,300 pounds per square inch. It is of interest to note in passing that at 900 degrees Fahrenheit and above piping and equipment will have a dull red glow in the dark.

Utilization of these elevated steam conditions has been progressive. Trends may be arranged in two general classifications. Prior to 1930, the marked change was an increase in steam pressure in boilers and turbines. Temperatures were increased, but not to the range of today. The maximum temperature for this first step was in the vicinity of 825 degrees Fahrenheit. During the period from 1925 to 1936 turbine capacities for these higher pressure units were comparatively small. The higher pressures thereafter were accepted, and steam temperatures showed a gradually rising trend from about 1939 on—the second step. Subsequent installations revealed a steady increase in capacities of turbines with the higher steam temperatures.

Advancement in the art of welding is a most necessary adjunct, since elevated pressure and temperatures have required the elimination of bolted, flanged joints wherever possible from the point of view of safety and economy. Welding processes have been developed to such an extent that most of the piping and most of the equipment in present-day plants may be welded most economically.

PLANT REHABILITATION

With the availability of new materials, thermodynamic research opened another major field of improvement. Many existing plants had been installed and were operating at pressures from 200 to 400 pounds per square inch and temperatures from about 500 to 700 degrees Fahrenheit. By installing high pressure boilers and turbine the exhaust steam from the latter could be utilized to drive the older turbines through existing steam piping kept practically intact. Installation of the new equipment, designed for operation at from 1,200 to 1,800 pounds per square inch pressure and 900–950 degrees Fahrenheit steam temperature resulted in rejuvenation of the older plant. The existing plant thereby was improved in efficiency, to an extent that permitted it to approach the economy of a new plant operating at the higher temperature and pressure. No new condensing equipment nor increase in circulating water were required with the additional capacity. Installation of the superposed turbine was an important factor in the postponing of obsolescence of low-pressure equipment and conserving material.

3,600 RPM TURBINE GENERATORS—HYDROGEN COOLING

In order to prevent operating difficulties from distortion and expansion, it was found desirable to reduce to a minimum the amount of material in contact with high-pressure and high-temperature steam. This called for turbine speeds of 3,600 rpm rather than 1,800 rpm generating units, which were the general practice for the power pressure range. Here again metallurgy was called upon, not for high-temperature metals, but for higher strength materials to withstand the forces de-

veloped in high-speed rotating parts. The larger 3,600 rpm machines are less than ten years old, and in addition to their lower cost, they are, in general, more efficient and use less material. Contributing to this latter feature is the use of hydrogen, a less dense gas, rather than air for cooling the generator. With hydrogen cooling, the rating of the machine can be increased about 20 per cent for a given amount of active material. The life of the winding insulation is increased as a result of the absence of moisture, oxygen, and dirt, and possibilities of damage to windings from other causes are reduced. A few cross compound hydrogen-cooled machines of 100,000-kw capacity, 1,250 pounds per square inch with 950 degrees Fahrenheit steam, have been in commercial operation at 3,600 rpm for several years.

STEAM GENERATING UNITS

Substantial changes have taken place in the design of boilers and allied equipment. Units for large outputs generally have been accepted, some in capacities as high as 1,000,000 pounds per hour evaporation. Boilers of 500,000 to 600,000 pounds per hour output are considered commonplace. Most of the larger boilers are pulverized coal fired. An attempt also has been made to design these units for adaptability to varying classifications of fuels. The use of alternate fuels also has been considered with favor. The latter item was brought to prominence during the year 1939 when a coal strike was in effect. The ready adaptability to oil or gas was quite advantageous. In other instances, although the units are not equipped with alternate burning devices, conversion possibilities were allowed for in their design.

Steam generating units of today bear no resemblance whatever to the boiler of 1925. Furnaces are universally water-cooled. Economizers and air preheaters have been added, whereas previously they usually were omitted. The superheater producing the high steam temperature has replaced some of the low-temperature heating surface, and, while the physical size of the unit has increased tremendously, the actual material per thousand pounds of steam produced has undergone a compensatory decrease. These changes in design also have increased the efficiency of steam production, so that now more energy in a fuel is converted to heat energy in the steam than was the case in the equipment of 1925.

INTERCONNECTION

Interconnection between systems by reducing the reserve capacity required, taking advantage of diversity, and permitting the operation of the most efficient plants in all systems for a greater number of hours has contributed not only to the safety of the systems so connected, but also to a noteworthy saving in fuel consumed. Interconnection permits each system to utilize with safety larger units than would be desirable with individual operation, and this, together with the saving of reserve capacity, likewise has been beneficial in conserving the raw materials which go into the building of a plant.

HYDROELECTRIC INSTALLATIONS

Where it has been economically feasible, the electrical utilities have installed hydroelectric plants to supply part of their power, and thus have contributed to the conservation of the nation's fuel supply. In 1925 the privately owned hydroelectric capacity was 5,600,000 kw, and in 1944 it was 8,800,000—an increase of 3,200,000 kw. In the meantime, the publicly owned hydroelectric plants, which had a capacity of 600,000 kw in 1925, increased 5,200,000 kw in capacity to 5,800,000 kw. As a further comparison, in the year 1944 the total energy produced in privately owned hydroelectric plants was 41,000,000,000 kilowatt-hours, and that produced in publicly owned plants 33,000,000,000 kilowatt-hours. This indicates that the electrical utility industry has not been remiss in utilizing hydroelectric energy where it was beneficial to the customers supplied.

HOW THE PUBLIC BENEFITS

A complete discussion of all improvements in power supply would be beyond the scope of this presentation. The foregoing outlines some of the major accomplishments in generation over the past era.

At the risk of repetition it can be stated that improvements in steam plant economy have conserved large quantities of fuel, and, together with centralized production permitting the use of larger units, have been responsible for the conservation of other natural resources of the country.

The power industry is ever alert in sponsoring and adopting sound improvements, and its facilities continually are being developed to meet any demands that may be imposed.

The fuel economy curve however is flattening out rapidly. With today's available heat cycles, further reduction in fuel consumption becomes increasingly difficult. Some other strategic point of attack may appear practicable later, such as direct conversion, in some manner, of heat energy in the fuel to electric energy. The adaptation of atomic energy, as it is now known, to commercial power production may be realized economically some time in the future, but the development stage for this process no doubt will be long and tedious, assuming it is found to be applicable to our ever-increasing requirements.

The result of all this activity since 1925 has been a steadily decreasing unit cost of electricity to the consumer (about 60 per cent of the 1925 cost) while in the meantime the cost of living index for the United States from the United States Bureau of Labor Statistics shows, despite a drop in the 30's, that during 1944 it was practically equal to that of 1925.

INSTITUTE ACTIVITIES

Pacific Coast Convention, Seattle, Wash., August 27–30, 1946

The Pacific Coast convention will be held in Seattle, Wash., August 27–30, 1946, with headquarters in the Olympic Hotel. Arrangements are being made for a full postwar program of eight sessions, including a session which affords an opportunity for discussion on organization of the engineering profession; entertainment; sports; and inspection trips in a picturesque part of the Pacific Northwest. For the women there will be scenic boat rides and automobile sightseeing tours to the various points of interest about the city. The need to make hotel reservations early is stressed, as explained further under the heading, hotel reservations.

ENTERTAINMENT

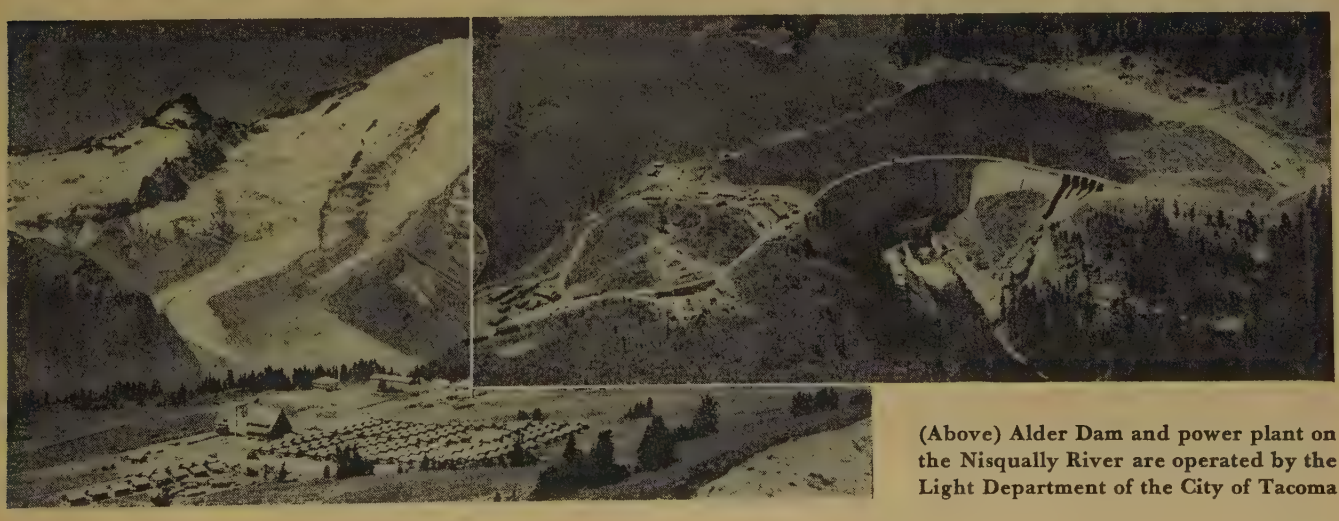
The major entertainment event will be the reception and banquet on Thursday evening. The reception will be held in the foyer outside of the Spanish Ballroom and will be followed immediately by the banquet. One feature of the banquet will be the presentation of the golf prizes from the tournament played the day before.

A theater party is planned for Wednesday evening at the Penthouse Theater. This is a theater at the University of Washington staffed entirely by students in the School of Dramatics.

Entertainment is being planned for the women who are registered at the convention. There will be scenic boat rides and automobile sightseeing tours to the various points of interest about the city. The floating bridge across Lake Washington will be of interest to many.

(Above) Lake Washington Floating Bridge at Seattle is a four lane highway one and one quarter miles long

Sunrise Valley (below) in Mount Rainier National Park is on the route to Yakima, Wash.



(Above) Alder Dam and power plant on the Nisqually River are operated by the Light Department of the City of Tacoma

Schedule of Events

All sessions to be held in the Olympic Bowl at the Olympic Hotel

Tuesday, August 27
8:00 a.m. Registration
10:00 a.m. Opening session
2:00 p.m. Central stations session
Wednesday, August 28
9:00 a.m. Industrial and railroad session
1:00 p.m. Golf tournament for the John B. Fisken Cup
2:00 p.m. Student papers session
8:00 p.m. Theater party
Thursday, August 29
9:00 a.m. Aviation session
2:00 p.m. Power systems session
7:00 p.m. Reception and banquet
Friday, August 30
9:00 a.m. Discussion on organization of the engineering profession
2:00 p.m. Communication

GOLF

The golf tournament will be held on Wednesday at the Inglewood Golf and Country Club. The tournament competition will be medal play on handicap in foursomes for the John B. Fisken Cup and other prizes.

INSPECTION TRIPS

There will be inspection trips during the convention and on Saturday, August 31. The trips in the city will include Boeing Aircraft Company, where the wind tunnel is of particular interest. The various substations of the Puget Sound Power and Light Company and the Seattle City Light Department will be visited. The University of Washington and various industrial plants, including lumber and plywood plants, will be inspected.

Out-of-town trips will include the Puget Sound Navy Yard at Bremerton and lumber and pulp mills at Everett. The Snoqualmie River hydroelectric plant of the Puget Sound Power and Light Company and the Nisqually River plant of the Tacoma City Light Department are nearby. Mount Rainier National Park is also within a few hours' drive of Seattle. The large Government power plants at Grand Coulee Dam near Spokane and at Bonneville Dam near Portland may be visited on the way to or from the convention. Victoria and Vancouver, British Columbia, in Canada may be reached by boat, rail, or car from Seattle.

HOTEL RESERVATIONS

Because of the limited space available at the Olympic Hotel, convention headquarters, and the overcrowding of all hotels in the city, members should make hotel reservations immediately. The committee has reserved 200 rooms (doubles, with twin beds only available); rates, $6, $7, $8, and $10 for two people, or from $3 to $5 per person. The committee cannot be assured of any single rooms. Please make reservations for the Olympic by writing to C. H. Cutter, chairman, hotel and registration committee, 814 Securities Building, Seattle 1, Wash., stating the price of room preferred and with whom you will share the room, as well as the time and date of arrival and departure. Reservations at other hotels should be made by writing directly to the hotel preferred.

ADVANCE REGISTRATION

Members of Districts 6, 8, and 9 and the Vancouver Section who will attend the convention should register in advance by filling in and mailing the advance registration card, which will be sent to them the first week in August. All others should register by writing to C. H. Cutter, chairman, hotel and registration committee, 814 Securities Building, Seattle 1, Wash. A registration fee of $2 will be charged all nonmembers except Student members and the immediate families of members.

COMMITTEES

Pacific Coast convention committee members are:

J. Hellenthal, *general chairman;* H. M. Gustafson, *vice-chairman;* H. R. Brown, *secretary;* G. M. Palo, *treasurer;* D. I. Anzini, C. B. Carpenter, E. S. Condon, O. A. Demuth, F. F. Evenson, J. P. Fraser, F. E. Gardiner, J. F. Gogins, L. D. Harris, E. A. Loew, F. O. McMillan, R. R. Richey, C. A. Rollins, W. C. Smith, C. F. Terrell.

Subcommittee chairmen are:

L. B. Robinson, *program;* E. B. Hansen, *finance;* C. H. Cutter, *hotel and registration;* R. E. Kistler, *publicity;* R. E. Lindblom, *student activities;* R. A. Walker, *transportation and trips;* C. R. Kingsbury, *golf;* H. R. Loew, *entertainment;* Mrs. C. S. Alger, *ladies' entertainment.*

Officers for 1946–47 Announced at Annual Meeting

Institute officers for the year commencing August 1, 1946, were announced in the report made by the committee of tellers to the annual meeting of the AIEE held in Detroit, Mich., June 26. The new officers are:

President: J. Elmer Housley, district power manager, Aluminum Company of America, Alcoa, Tenn.

Vice-Presidents: E. W. Davis, chief electrical engineer, Simplex Wire and Cable Company, Cambridge, Mass. (District 1, North Eastern); O. E. Buckley, president, Bell Telephone Laboratories, Inc., New York, N. Y. (District 3, New York City); T. G. LeClair, staff engineer, Commonwealth Edison Company, Chicago, Ill. (District 5, Great Lakes); R. F. Danner, general superintendent, Oklahoma Gas and Electric Company, Oklahoma City (District 7, South West); C. F. Terrell, vice-president, Puget Sound Power and Light Company, Seattle, Wash. (District 9, North West).

Directors: J. F. Fairman, vice-president in charge of production, Consolidated Edison Company of New York (N. Y.), Inc.; R. T. Henry, chief electrical engineer, engineering department, Buffalo (N. Y.), Niagara, and Eastern Power Company; E. P. Yerkes, engineer of equipment and buildings, eastern area, Bell Telephone Company of Pennsylvania, Philadelphia.

Treasurer: W. I. Slichter, professor emeritus of electrical engineering, Columbia University, New York, N. Y.

The board of directors for the administrative year commencing August 1, 1946, will consist of the foregoing elected officers and the following holdover officers:

William E. Wickenden, Cleveland, Ohio (retiring president); Charles A. Powel, East Pittsburgh, Pa. (junior past president); F. F. Evenson, San Diego, Calif.; E. S. Fields, Cincinnati, Ohio; F. L. Lawton, Montreal, Quebec, Canada; L. M. Robertson, Denver Colo.; H. B. Wolf, Charlotte, N. C. (*vice-presidents*); P. L. Alger, Schenectady, N. Y.; J. M. Flanigen, Atlanta, Ga.; C. M. Laffoon, East Pittsburgh, Pa.; M. J. McHenry, Toronto, Ontario, Canada; C. W. Mier, Dallas, Tex.; S. H. Mortensen, Milwaukee, Wis.; J. R. North, Jackson, Mich.; D. A. Quarles, New York, N. Y.; Walter C. Smith, San Francisco, Calif. (*directors*).

1946 Lamme Medal Nominations Due December 1

Special attention is directed to the fact that the names of Institute members who are considered eligible for the AIEE Lamme Medal, to be awarded early in 1947, may be submitted by any member in accordance with section 1 of article VI of the bylaws of the Lamme Medal committee, as follows:

The committee shall cause to be published in one or more issues of *Electrical Engineering*, or of its successors, each year, preferably including the June issue, a statement regarding the Lamme Medal and an invitation for any member to present to the secretary of the Institute by December 1, the name of a member as a nominee for the medal, accompanied by a statement of his "meritorious achievement" and the names of at least three engineers of standing who are familiar with the achievement.

Each nomination should give concisely the specific grounds upon which the award is proposed, and also a complete detailed statement of the achievements of the nominee, to enable the committee to determine its significance as compared with the achievements of other nominees. If the work of the nominee has been of a somewhat general character in co-operation with others, specific information should be given regarding his individual contributions. Names of endorsers should be given as specified in the foregoing quotation.

June Supplement in Preparation. Discussions which have been submitted on the technical papers published in the January–June monthly Transactions sections of *Electrical Engineering* will appear in the June 1946 "Supplement to Electrical Engineering—Transactions Section" soon to be released. This will complete the publication of papers and discussions presented at the New York winter convention, all of which will be in the 1946 *Transactions* volume.

Future AIEE Meetings

Pacific Coast Convention
Seattle, Wash., August 27–30, 1946

Great Lakes District Meeting
Fort Wayne, Ind., September 25–27, 1946

Report of the Board of Directors

THE BOARD OF DIRECTORS of the American Institute of Electrical Engineers presents herewith to the membership its 62nd annual report, for the fiscal year ending April 30, 1946. It includes a general balance sheet and other statements, showing the financial condition of the Institute at the close of the fiscal year, and a brief summary of the principal activities of the Institute during the year, more detailed information having been published from month to month in *Electrical Engineering*.

BOARD OF DIRECTORS' MEETING

Five meetings of the board of directors were held during the year, four in New York, N. Y., and one in Cleveland, Ohio. Four meetings of the executive committee were held.

Information regarding many of the more important activities of the Institute which have been under consideration by the board of directors and AIFE committees is published each month in the section of *Electrical Engineering* devoted to Institute activities.

PLACES VISITED BY PRESIDENT WICKENDEN

California
Los Angeles Section; San Diego Section
San Francisco Section
University of California Branch, Berkeley

Canada
Montreal Section; Toronto Section
Vancouver Section

Colorado
Denver Section
University of Colorado Branch, Boulder

Connecticut
Connecticut Section, New Haven
University of Connecticut Branch, Storrs

District of Columbia
Washington Section

Florida
Florida Section, Miami
University of Florida Branch, Gainesville

Georgia
Georgia Section, Atlanta

Idaho
University of Idaho Branch, Moscow

Illinois
Chicago Section; Illinois Valley Section, Peoria

Indiana
Central Indiana Section, Indianapolis
Fort Wayne Section

Massachusetts
Joint meeting in Boston of Boston, Lynn, Providence, and Worcester Sections
Northeastern University Branch, Boston
Pittsfield Section; Springfield Section

Michigan
Michigan Section, Detroit
Summer Convention, Detroit

Missouri
Kansas City Section
St. Louis Section

New York
New York Section, Nutley, N. J.
North Eastern District Meeting, Buffalo
Winter Convention, New York

North Carolina
North Carolina Section, Raleigh
Southern District Meeting, Asheville

Ohio
Cincinnati Section; Cleveland Section
Dayton Section

Oregon
Portland Section

Pennsylvania
Philadelphia Section
Pittsburgh Section

South Carolina
South Carolina Section, Columbia

Texas
South West District Meeting, San Antonio

Utah
Utah Section, Salt Lake City

Virginia
Virginia Section, Richmond

Washington
Seattle Section
Spokane Section
State College of Washington Branch, Pullman

ANNUAL MEETING

On account of the cancellation of the regular summer convention, the annual meeting of the AIEE was held in the Engineering Societies Building, New York, June 27, 1945. The annual report of the board of directors for the fiscal year which ended April 30, 1945, was presented in abstract by the secretary, and the treasurer's report was presented by W. I. Slichter. Reports of the committee of tellers on votes for officers for the year to begin on August 1, 1945, and for the proposed amendments to the constitution were presented.

President-Elect Wickenden responded to his introduction with a brief address. Awards of Institute prizes were reported and presentations made to the winners. The election of Doctor C. E. Skinner as an honorary member was announced. The Lamme Medal was presented to Doctor S. H. Mortensen. The meeting was concluded with a brief review of Institute activities during the year by C. A. Powel, president.

WINTER CONVENTION

The 34th winter convention was held in New York, January 21–25, 1946, with a registration of 2,624, an all-time record. The program included 17 technical sessions, 8 conferences, and 3 symposiums, at which 78 technical and 24 conference papers were presented, a conference on Institute activities, a general session, and a joint evening session with the Institute of Radio Engineers. Other events were a dinner-dance; smoker; women's luncheon, bridge, and fashion show; and inspection trips.

In the general session, the Edison Medal was presented to Philip Sporn, executive vice-president, American Gas and Electric Service Corporation, New York, and an address on "Development of Atomic Energy" was delivered by Doctor J. R. Dunning, director of the division of war research, Columbia University, New York, and technical adviser, The Kellex Corporation.

The joint session with the IRE on Wednesday evening was devoted to the presentation of the Hoover Medal to Doctor W. H. Harrison, vice-president, American Telephone and Telegraph Company, New York, and an address on "Some Electrical Engineering and General Aspects of the Atomic Bomb Project" by Major General Leslie R. Groves.

DISTRICT MEETINGS

South West District Meeting. This meeting was held in San Antonio, Tex., April 16–18, 1946, with a registration of 366. The principal sessions included 5 technical, one on electrical problems in Mexico, one general, one for student papers, and one for a general discussion of Institute activities. Other events were a banquet, smoker, inspection trip to Randolph Field, luncheon meeting of the District executive committee, and luncheon meeting of the Student Branch counselors.

North Eastern District Meeting. Held in Buffalo, N. Y., April 24–26, 1946, this meeting had been postponed, on account of wartime travel congestion, from the spring of 1945. The registration was about 400. The chief activities were 8 technical sessions, a conference on quality control, a general luncheon, a banquet, a dinner and smoker, a student technical session, a District executive committee luncheon, a Branch counselors' and chairmen's luncheon, inspection trips, a women's luncheon, and a visit to Niagara Falls and dinner for women.

COMMITTEE ON COLLECTIVE BARGAINING AND RELATED MATTERS

The committee's tentative report was published in the July 1945 issue of *Electrical Engineering*, and this report was given publicity by several of the other engineering societies by publication, or by mailings, to members. Also, in December 1945, the AIEE Sections committee mailed copies of the report to all AIEE Section chairmen suggesting discussions of it at Section meetings. The chairman and the secretary of the committee on collective bargaining and related matters have talked on this subject at several AIEE Section meetings. In all of these efforts at giving publicity to the tentative report, members have been urged to read the report and to send in comments and criticisms. To date less than 50 such comments have been received by the committee.

The interest in the subject, particularly on the part of younger engineers, continues at high level, but manifests itself in the form of inquiries pertaining to specific cases of attempts to place engineers in bargaining groups not of their own choosing, rather than in comments on the committee's tentative report.

The preparation of a manual on the subject of collective bargaining, as it relates to professional employees, has been followed actively by the committee and its consultant, Doctor Waldo Fisher, during the past year. Several chapters have been written and have been reviewed by the committee. To carry out this work, two two-day meetings of the committee with its consultant were held, one in September 1945 and the other in January 1946. Another such two-day meeting is scheduled for May or June

1946. It is expected that the drafting of the manual will be completed during the fall of 1946.

The AIEE committee on collective bargaining and related matters is collaborating with the committee on collective bargaining under the committee on the economic status of the engineer (Engineers Joint Council), and it is expected that the final wording and arrangement of the manual will have the approval of the committee on the economic status of the engineer. Such approval, it is hoped, will lead to joint publication of the manual by the several engineering societies participating in the work of the committee on the economic status of the engineer.

The committee has under consideration the mailing of a questionnaire to all members to obtain their views on the matter of collective bargaining by professional employees, and on federal legislation affecting such collective bargaining. The committee is hopeful that such a questionnaire might be handled through the committee on the economic status of the engineer, and go to the combined membership of the engineering societies participating in the work of the latter committee.

COMMITTEE ON REGISTRATION OF ENGINEERS

On August 28, 1945, the conference committee on Model Law met to consider revisions of definitions. A report on the actions of the meeting was published in *Electrical Engineering* for May 1946, in connection with the complete text of the Model Law.

This revision was discussed by the American Society of Civil Engineers' committee on registration of engineers at its meeting in January 1945, at which time the revision of the second paragraph of Section 13 was recommended as quoted.

The AIEE was invited to endorse the new draft. At the January 25th meeting of the AIEE board of directors, the following resolution was presented and adopted.

RESOLVED, that the AIEE recognizes the registration of engineers as a continuing practice and the Model Law for the registration of professional engineers and land surveyors, as adopted in 1943 and amended in 1945, as the widely accepted basis of its administration, and that the Institute endorses these procedures as well established.

In view of this more positive action and changed position of AIEE, it was recommended that a new standing committee be appointed replacing the present committee on registration of engineers and that it have a scope of responsibility covering matters related to registration, to be reported at a subsequent meeting. (This recommendation was adopted.) The drafting of scope was referred to the committee on planning and co-ordination.

Notification of AIEE endorsement has been sent to the ASCE sponsors of the Model Law and to the conference committee of the various societies.

The present Model Law is the result of compromise and is subject to revisions when needed and proposed by the conference committee for endorsement by constituent societies. In order for the new standing committee to be thoroughly representative of AIEE thought, it will be necessary for Sections to follow developments in their localities and inform the standing committee of local conditions and the considered reactions of their members, together with suggestions for desired alterations in Model Law.

General Committees

SECTIONS COMMITTEE

1. Section Programs. The Sections generally have been following a program of expanding their activities to meet the increased scope and growing demands of the electrical industry and to provide for the diversification of interest of the Section members. With the end of the war, it has been possible to give increased attention to student activities, social activities, more fellowship at meetings, inspection trips, and the broader subject of civic responsibilities of engineers. During the past year, Section officers have been generally more conscious of the importance of balanced Section operation, which provides activities to retain the older members as well as attract new members. In giving more time to creative work and the co-ordination of the activities of their Sections, many Chairmen have followed the suggestion of delegating to committees much of the operating work of running the Section. The increase in operating committees in the Section has resulted in more members working actively for the Section, which in turn has created additional interest.

2. Sections Committee Organization. Because of the volume of the Sections committee work, the committee again was organized at the beginning of the year into two groups. The planning group, consisting of six members, initiates and develops all plans of the committee. The promotional group consists of ten members located geographically on a District basis, making it possible to handle much of the promotional work individually with the Sections. Most of the material used by the promotional group is sent to each member, who in turn supplements it with his personal knowledge of local conditions, before contacting the Sections in his District. Close contact is maintained between the promotional group member and the vice-president of the District.

3. Conferences on Section Operation and Management Held in Connection With District Meetings. Due to the cancellation of the summer technical meeting in 1945, the usual delegates meetings were not held. A program for conferences on Section operation and management was developed by the Sections committee to be held at the individual District meetings early in the fall of that year. These meetings were presided over by the vice-president of each District. A detailed outline of the suggested conference was prepared by the Sections committee for the information and guidance of the vice-presidents. No conference was held in District 3—New York, and District 10—Canada. The Sections of the Canadian District divided their attendance between the meetings held in District 1 and District 9. These meetings were very successful as a substitute program for the regular delegates meetings and provided the Section officers with much information, enthusiasm, and inspiration for the conduct of the affairs of the Sections. The promotional group representatives of the Sections committee received special travel allowance to attend their respective meetings in each District.

These meetings were so well received by Section officers that the Section representatives recommended, at the Sections committee meeting in New York, January 22, 1946, that these District conferences on Section operation and management be continued as a supplement to the regular delegates meetings, which will be held at the summer convention.

4. Technical Groups. The development of technical groups is a very important part of the plan to retain the diversified interest of the older members as well as attract new members. The Sections committee sent a copy of the folder "Technical Groups" to each Section chairman at the beginning of the year and, through its promotional group, has been making individual contacts with those Sections where there is a possibility of the successful operation of these technical groups. The promotional group also has been supplying individual Sections with reports of examples of successful operation of these technical groups. The value of such groups operated within the Section is becoming more generally recognized throughout the country. There were 51 groups in active operation at the end of the 1944–45 operating year. Reports received from the Sections indicate 23 new technical groups have been formed to date this year. Many other groups are in process of being formed. The Sections have been asked to explore thoroughly their area to make certain that they have the entire field of electrical engineering covered by suitable technical groups.

5. Subsections. Subsection operation is a valuable means of accomplishing the important objective of the Institute, by providing additional meeting places at which papers on electrical engineering subjects may be presented and discussed. With all the territory in the continental United States allocated to the Sections, the next logical step forward in the development of Section activities was to form Subsections or additional centers of electrical engineering influence. Many opportunities exist for members in the remote areas of a Section territory to participate in Section activities through the development of Subsections in these area. A copy of the folder "Subsections" was sent to each Section chairman at the beginning of the year, and the promotional group of the Sections committee has encouraged the Sections to consider the opportunities which exist for the formation of additional Subsections. Examples of successful operation of Subsections were sent to the individual Sections by the promotional group. Subsection operation is becoming more popu-

lar each year as its advantages are more widely recognized. Ten additional Subsections have started operation during the year, and there are now 25 Subsections in active operation. Many additional locations for Subsections are being considered by the Sections.

6. Local Councils of Engineering and Technical Societies. Participation of AIEE Sections in the work of the local council in their community provides a means by which the Section members can engage in civic, legislative, and other similar broad activities of the engineering profession without the necessity of joining additional societies. Interest in these local councils during the past year has been very great throughout the country. There are now 43 councils in active operation, about half of which have been formed since 1940. Several additional councils are in process of being formed. In most cases not only the local AIEE Section has been very active in forming these councils, but also the members of the local AIEE Sections have been very active in the work of these councils. This activity has been encouraged during the past year by the Sections committee. On February 8, 1946, a letter was sent to all Section chairmen on the subject of these local councils. The promotional group has distributed to the Sections examples of the successful operation and organization of these local councils in various parts of the country. This Sections committee activity was designed to encourage AIEE Sections to become active in the formation of local councils in their areas where these councils do not exist and to encourage the Sections to become more active in local councils now in operation.

The Institute has representatives on a committee of the Engineers Joint Council for the organization of the engineering profession. This committee has approved for distribution to the local sections of the various societies, a report on the organization of local councils which closely parallels the information previously sent out by the Sections committee. The Sections of the co-operating societies have been requested to furnish certain information concerning local councils now in operation. This information is to be used by the committee to develop plans for regional and national organizations for the engineering profession.

7. Section Finance. In co-operation with the finance committee of the Institute, plans were formulated to provide for certain increases in appropriations to those Sections operating Subsections and technical groups. The plan for these additional appropriations was approved in principle by the executive committee of the Board of Directors and referred to the finance committee. The proposed increases will cover the cost of the expanded activities of the Sections, and it is hoped that final approval will be obtained to place them in effect for the 1946–47 operating year.

8. Student Activities. In co-operation with the committee on Student Branches, the Sections committee has developed a plan of co-operation between the AIEE Sections and the Student Branches. This plan was distributed simultaneously on April 1, 1946, to the officers of each Section and Branch, Student Branch counselors, vice-presidents and District secretaries. Under postwar conditions, the Student Branches are resuming normal activities. It is essential that the AIEE Student Branches develop, as early as possible, the interest of those students who select electrical engineering. The Sections can assist materially in this important activity. Such help from the Sections gains increased importance now because of the maturity of those returning to electrical engineering studies after service in the Armed Forces.

9. Educational Courses. In co-operation with the committee on education, the Sections committee released a letter to all Sections calling attention to the opportunities for additional Sections of the Institute to perform a worth-while service by offering educational courses to their members and others. The letter explains how these courses are conducted and lists several suggestions on possible courses which could be offered at the beginning of the 1946–47 operating year.

10. Changes in Section Territory. The following changes in Section territory were made during the year:

The Mexico Section was transferred from District 3 to District 7. This transfer was made with the approval of the vice-presidents of the two Districts concerned. The negotiations for the approval of the Mexico Section were handled by the Sections committee. This transfer places the Mexico Section in direct contact with the adjoining territory, which has resulted in increased interest of the Mexico Section in the affairs of the Institute.

The formation of the Illinois Valley Section was approved by the Board of Directors at its meeting on May 29, 1945. The territory of this Section comprises 22 counties in the State of Illinois, which were previously a part of the Urbana Section. This new Section was formed with the approval of the Urbana Section and the vice-president of District 5.

The formation of the Beaumont Section was approved by the Board of Directors on June 27. This Section comprises 13 counties in the State of Texas, which were formerly the territory of the Houston Section. This new Section was formed with the approval of the Houston Section and the vice-president of District 7.

11. Annual Report of Section Chairmen. An annual report of Section chairmen was prepared by the Sections committee and distributed to all Sections at the close of the 1943–44 operating year and the 1944–45 operating year. This report provides a simple analysis of major activities and the organization of all Sections and contains much information of value to new Section officers in laying out their Section program for the year. This report also is sent to all vice-presidents, District secretaries, and the chairmen of all national committees. Due to the wide acceptance of this report, it is planned to continue this feature at the close of the present operating year.

12. Section Operating Committees. On November 28, 1945, a letter was sent to all Sections suggesting the formation of additional Section operating committees in order to handle properly the increased activity within the Sections. The annual report of Section chairmen showed 348 committees reported for 1943–44, as compared with 410 committees reported for 1944–45. A list of suggested committees was given in this letter to the Sections. It was pointed out that spreading the work of the Section by the use of additional committees provides an opportunity for more members to participate actively in the work of the Section.

13. Section News Items for Electrical Engineering. A letter has been released to all Sections requesting news items for publication in *Electrical Engineering* and again requesting articles on subjects presented at Section meetings for possible publication in the general interest section of *Electrical Engineering*. This activity has the approval of the publication committee and was prepared with the co-operation of the editor of *Electrical Engineering*.

14. Co-operation With Other National Committees. In addition to close co-operation with the vice-presidents, certain features of the Sections committee program were co-ordinated with the Institute finance committee, membership committee, committee on Student Branches, and the committee on education.

Each of the Institute technical committees also was approached in an effort to obtain the co-operation of these committees in the development and operation of technical groups within the Sections. Several technical committees have participated actively in this program during the year, and it is believed that this work will serve as a pattern in the future for greater co-operation within the Institute.

15. Delegates Meetings at Summer Convention. The Sections committee has prepared a comprehensive program for the Institute officers, Section delegates, and members at the summer convention at Detroit. Three parallel conferences on Section operation and management will be conducted on June 24th, with the delegates divided into groups representing the larger, intermediate, and smaller Sections. The conference of officers, delegates, and members will be held on June 25th. On June 26th a conference on Section activities in connection with local councils of engineering and technical societies will be held, and on June 27th a conference on Section–Branch co-operation is scheduled as a joint activity of the Sections committee and the committee on Student Branches.

16. Committee Meetings. Due to the nature of the Sections committee work, the activities of the committee were carried on by means of correspondence. One meeting was held by the committee on January 22, 1946, in New York during the winter convention, with an attendance of 51. At this meeting the entire Sections

Table I. Section and Branch Statistics

	For Fiscal Year Ending April 30					
	1941	1942	1943	1944	1945	1946
Sections						
Number of Sections	72	72	73	73	73	75
Number of meetings held	703	647	598	738	884	1,210
Total attendance	92,554	78,254	66,111	83,120	96,346	113,531
Branches						
Number of Branches	123	124	125	125	125	125
Number of meetings held	1,163	946	942	755	547	716
Total attendance	52,285	37,785	38,227	24,768	17,132	22,844

committee program was reviewed, and plans for the remaining portion of the year were discussed. Minutes of this meeting were sent to all who attended and in addition were sent to all vice-presidents, District secretaries, and Section chairmen.

COMMITTEE ON STUDENT BRANCHES

The committee on student branches during the current year has exerted its efforts primarily toward the conversion of Student Branches from uncertain wartime operation to a stable, yet flexible, program of peacetime operation.

A major step has been taken in the reinauguration of District student conferences in connection with District meetings. Successful conferences in somewhat modified form have been held at the South West District meeting, San Antonio, April 16–18, and at the North Eastern District meeting, Buffalo, April 24–26. A more comprehensive conference has been planned and seems definitely destined for success at the Southern District meeting, Asheville, May 14–16.

For some time, a subcommittee on joint Student Branches, with J. F. Calvert as chairman, and comprising M. S. Coover, M. M. Cory, and J. E. Hobson, studied the possibilities of the operation of joint AIEE-IRE Student Branches, and at a meeting of the committee on Student Branches held in New York at the time of the winter convention, January 22, 1946, made the following recommendations, which were accepted by the committee on Student Branches and approved by the board of directors of the AIEE:

1. It is recommended that insofar as the establishment of joint AIEE–IRE Student Branches is concerned, that such branches not only should be permitted, but also should be encouraged, in accordance with the principles stated in the recommendations of the committee on planning and co-ordination. This should not be considered to oppose similar joint action with other technical societies.

2. It is recommended further that the board of directors of the AIEE be requested to take appropriate action in co-operation with the proper representatives of the IRE, and at the earliest opportunity, to arrange all details essential to the successful operation of these proposed joint Student Branches.

This means that Student members in either AIEE or IRE automatically share equal rights in joint Student Branches, in addition to the advantages offered by their particular society, and are eligible for admission to a regular membership grade in either participating society without entrance fee. It is hoped that such joint Student Branches eventually will include Student members of other societies of similar type and policy. The plan proposes, in general, an engineering council at the Student member and Student Branch level.

It is not intended that the identity of AIEE Student Branches be lost, for there will be many subjects and meetings of prime interest to AIEE Student members and of little or no interest to IRE members. Such meetings, as well as AIEE Student District conferences, and joint activities with AIEE Sections and Districts, will maintain the identity and independence of AIEE Student Branches, even while cooperating within their schools in joint Student Branches as recommended.

Arrangements also have been made to distribute in reprint form the excellent series of three articles on "The Unwritten Laws of Engineering" by W. J. King, formerly of the General Electric Company, and now with Battelle Institute.

After acceptance of these recommendations by the board of directors, this same subcommittee was requested to study and develop policies, programs, and practices, using Student Branches in the Chicago area as pilot projects, and to report their findings and recommendations to the committee on Student Branches at its annual meeting in connection with the summer convention in Detroit, June 24–28, 1946.

FINANCE COMMITTEE

Institute revenue has been sustained at a high level for the fiscal year as a consequence of growth in membership and a steady demand for Institute publications. Attention is directed to the detailed financial statements on pages 18, 19, and 20, and especially to Exhibit B in which report is made on cash receipts and disbursements, and the excess of income over expenditures is shown.

The budget presented to and approved by the board of directors provided for the effective continuance of all Institute activities and proper participation by the Institute in matters of common interest with other technical societies and associations. All expenditures have been in accordance with the intent of the budget items, some upward revisions of detailed figures having to be made to meet rising costs, especially iu connection with items concerned with the publication of *Electrical Engineering*.

An amount of $1,762.38 was placed in the Member-for-Life fund, and the excess of income over expenditures has permitted the transfer of approximately $120,000 to the reserve capital fund. In addition, the Institute received last fall a bequest of $10,652 from the late W. S. Barstow without restrictions as to its use. This amount also was transferred to the reserve capital fund, and all such amounts invested in appropriate securities.

As of May 1, 1946, 1,800 members were on inactive status in accordance with the established policy to grant dues concessions on requests to those serving in the Armed Forces and merchant marine. The foregoing figure compares with 2,259 members in such status as of May 1, 1945.

A summary of the securities owned by the Institute as of April 30 is presented in Schedule 1. A substantial portion of the reserve capital fund is in United States Government bonds, and the market value of other securities will be noted to be favorable. The finance committee avails itself continuously of the advice of investment counsel in connection with the purchase and other negotiations concerned with securities, and all items in the present portfolio fund have been approved from the standpoints of appropriateness and diversification.

Institute expenditures are budgeted to come within anticipated income, and the present sound financial condition reflects the conservative policy that has been followed over the years. The steady growth of the reserve capital fund is indicative of the ability of the Institute to render the character of service to the membership that may be indicated to be desirable and gives assurance with regard to the availability of funds to continue at proper level essential activities at such times as income might be temporarily affected by unforeseeable influences or economic conditions.

TECHNICAL PROGRAM COMMITTEE

Reconversion Programs. With all Institute and District meetings, except the winter meeting, canceled in 1945 and with various strike situations in 1946 the arrangement of adequate technical programs during the reconversion period has been difficult. To substitute for the canceled 1945 meetings, spring, summer, and fall technical paper programs, with preprints of the papers available, were announced nationally and offered for discussion by mail. A comparison of the number of papers offered on the three programs by mail with the number of papers for the three corresponding meetings of the previous 12-month period is of interest. The results shown in Table II represent a 49.1 per cent decrease in the number of papers offered, notwithstanding the special efforts that were made to announce the substitute plans in advance and solicit papers to keep pace with the many developments. The comparison serves to illustrate the value of technical meetings as a stimulus for the production of technical papers on new developments to keep the membership informed of advances in the profession.

The 1946 winter convention was an outstanding success with a registered attendance of 2,624, which exceeded all previous records. Among the high lights of this convention was an address on the de-

velopment of atomic energy by Doctor J. R. Dunning at the general session, followed by an address in the evening on "Some Electrical Engineering and General Aspects of the Atomic Bomb Project" by Major General Leslie R. Groves, and a symposium on nuclear energy which brought together the views of well-known people in the fields of physics and research. The number of papers presented for the year and the number recommended for the *Transactions* are shown in Table III.

Analysis of Subject Matter. The papers for the year have been analyzed on a percentage basis and classified into six broad fields of electrical engineering. In Table IV, the classification is compared with an occupational analysis of the membership made in 1940. When it is considered that those engaged in electrical manufacturing and educational work have considerable interest in all of these fields, the comparison indicates a reasonably close correlation between the percentage of papers presented in the first three fields and the percentage of the membership occupied in those fields. With the abandonment of wartime restrictions, it is apparent that material in the industrial and communication fields has come to the fore. The 20.3 per cent papers in the industrial and railroad fields represents a fairly uniform distribution of subject matter into subjects such as electric welding, industrial distribution, quality control and statistical methods, induction and dielectric heating, industrial control, and railways. In the field of communication, seven of the papers were on the subject of radar. As might be expected with the end of the war, the number of air transportation papers has decreased from a high of 37.5 per cent for the previous year to 13.1 per cent for the past year. The program for the forthcoming summer convention will bring forth additional papers in the fields of communication, industrial control, and servomechanisms, which heretofore have been highly restricted.

Exploratory Work. The committee has worked in close co-operation with the committee on planning and co-ordination in connection with the study of the organization of the engineering profession and the technical activities of the Institute. The technical committee chairmen have analyzed the methods of operation of some 44 other engineering societies, as a background for further consideration in organizing the technical activities. With a membership of 24,526 on January 1, 1946, and an increase of 1.33 per cent since January 1, it is not unreasonable to expect an average membership for the next five years of 28,000 members and an average number of papers per year of approximately 270. The increase in membership and the average number of papers during two 5-year periods is shown in Table V. Steps already have been taken to provide for this expansion and to keep the membership fully informed of new developments in the field of electrical engineering.

The committee has recommended that the chairmen of technical committees review all contacts with similar committees of other organizations and explore the possibilities of establishing new contacts in accordance with Section 86 of the bylaws. Closer ties with the District meeting committees and Sections have been suggested, with the recommendation that technical committees give consideration to planning important sessions on specific subjects appropriate for the localities of District meetings. It was further recommended that the Institute should adopt the policy of supplementing the three national conventions with another national convention to be held annually in the Midwest in October.

Table II. Comparison of Programs by Mail, When Meetings Were Restricted, With the Programs for the Three Previous Corresponding Meetings in 1944

	Transactions Papers		Transactions Papers
Spring technical paper program	19	Boston	12
Summer technical paper program	31	St. Louis	85
Fall technical paper program	30	Los Angeles	60
Total	80	Total	157

Per cent decrease $\frac{157-80}{157}$ = 49.1 per cent

Table III. Number of Papers Presented During the Year Ending April 30, 1946

	Number of Papers	Number of Transactions Papers
Spring technical paper program	19	19
Summer technical paper program	31	31
Fall technical paper program	30	30
Winter convention	78*	68
San Antonio meeting	21	3
Buffalo meeting	33	2
	212	153

* Includes 3 representations from summer and fall technical paper programs.

Discussions are being carried on with the publication committee to permit publication of papers arising from joint meetings with other societies. The technical program committee and the publication committee are working jointly on an analysis of suggestions received through the study of the Institute's technical activities which pertain to publication policies.

To provide greater interest for younger members, the committee has recommended that a study be made with a view toward holding commercial exhibits at conventions rather than excluding them. The committee also recommended to the winter convention committee that the next winter convention be held in a hotel rather than in the Engineering Societies Building.

PUBLICATION COMMITTEE

The publication activities during the year have been influenced strongly by the termination of hostilities in World War II, which lifted many wartime controls, and by the cancellation of AIEE national and District meetings after February 1, 1945, which greatly reduced the material available for publication. Publication policies and procedures remained unchanged as papers and discussions resulting from the technical paper programs, which replaced the usual meetings, were treated in the normal manner.

In accordance with current publication policies, the 1945 *Transactions* volume contains all approved 1945 technical papers

Table V. Growth in Membership and Expected Average Number of Papers in the Next Five Years

	Approximate Average Membership	Average Number of Papers Per Year
5-year period following 1925	18,000	160
5-year period following 1940	20,000	200
5-year period following 1945	28,000*	270*

* Forecast.

Table IV. Comparison of Classification of Papers in Six Broad Fields With an Occupational Analysis of Membership as of 1940

	Per Cent of Papers	Occupational Analysis of Membership (1940 Survey)	
Central stations	27.4	Light and power	25.5
Communication	13.7	Communication	9.7
Industrial and railroad	20.3	Industrial and railroad	11.4
Air transportation	13.1	Government	5.9
Electric machinery	14.4	Electrical manufacturing	25.8
Basic sciences and measurements	11.1	Educational	5.4
		Consultants and large contractors	4.4
	100 per cent	Miscellaneous	11.9
			100 per cent

and related discussions. Two semiannual "Supplements to Electrical Engineering—Transactions Section" were produced, on the usual limited-edition advance-order basis, containing (1) technical papers that could not be accommodated in the monthly *Transactions* sections of *Electrical Engineering*, and (2) all approved discussions.

Relaxation of strict censorship controls was reflected in the increased content devoted to wartime developments.

The easing of restrictions on paper supply permitted a return in January 1946 to the larger trim size and to the format that had been used in *Electrical Engineering* in 1943. A paper somewhat heavier than that used in 1945, but still not so heavy as the prewar paper, also was obtained.

The reduction in material for publication caused primarily by the cancellation of meetings, but possibly influenced also by the letdown following the end of fighting, is shown by a comparison of the numbers of pages of various classes of material published in the calendar years 1944 and 1945, as compared with 1941 as the last prewar year:

Numbers of Pages of Published Material

	Electrical Engineering			Transactions Only		
Year	General Interest Articles	News	Transactions Section	Technical Papers	Discussion	Total
1941	337	281	600	542	268	2,028
1944	246	214	738	493	231	1,922
1945	255	225	736	121	143	1,486

It may be noted that the number of pages in the "Transactions" section of *Electrical Engineering* in 1945 was maintained by publishing therein a greater proportion of the year's total of technical papers than was done in 1944. The use of a paper of lighter weight and the easing of paper restrictions in the latter part of 1945 permitted the number of pages in *Electrical Engineering* to be held at a fair level in spite of an increase in the number of copies printed, from 26,250 in December 1944 to 28,750 in December 1945. It was possible also to restore the 1945 annual report of the AIEE board of directors and the annual reference index to complete circulation. Only a limited distribution had been made in 1944 in order to conserve paper for text pages.

Advance pamphlets of approved technical papers were produced as required by the technical program committee for discussion by mail on summer and fall programs in 1945, and for regularly scheduled meetings beginning with the winter convention in January 1946.

The quarterly AIEE "Bulletin" for Institute members in the armed services was continued through the issue of February 1946. The number of members receiving the "Bulletin" decreased rapidly with the demobilization of the Armed Forces.

Revision of the booklet, "Information for Authors," to which reference was made in last year's report of this committee was deferred.

MEMBERSHIP COMMITTEE

It is quite interesting to note at this time that the growth in membership for the year 1945–46 has exceeded by a considerable margin the gain of any previous year in the history of the Institute. The net gain is 2,018 which brings the total membership to 25,090. The rate of gain in 1945–46 was 8.7 per cent, and the rate of gain for the 1944–45 period was 7.8 per cent. In the past two years, the numerical net gain has been 3,683. Judging from the rate at which new applications and applications from former members for reinstatement or re-election are being received, it would appear that the membership for the coming year is destined to continue to increase at a high rate.

The number of persons who were classified as having an "inactive status" because of military service or for other causes resulting from World War II was 2,259 at the end of the fiscal year 1944–45. This number increased to approximately 2,500. However, on April 30, 1946, the total had dropped to 1,809. This is a favorable trend and demonstrates the desire of the persons in this classification to return on their own motion to active membership status as promptly as possible. The policy of the Institute in this connection seems to have proved to be quite beneficial.

Starting in the year 1942, a renewed interest in the Institute was manifested by persons who had been members formerly. During that year, 237 were either reinstated or re-elected to membership. In 1943–44 the number in this group was 301. The corresponding numbers for the years 1944–45 and 1945–46 are 366 and 401, respectively. This trend is significant, as is the fact that the number in arrears for the fiscal year April 30, 1946, is only 954 or 3.8 per cent of the total membership. It will be recalled the corresponding number for those in arrears for 1944–45 was 902.

The number of transfers from the Associate and Member grades to higher grades of membership was 559. This number corresponds with totals of 464 and 420, respectively, for the years 1944–45 and 1943–44.

The total losses in membership for the year (Deductions, Table VI) was 600, or 102 lower than in 1944–45. From the same table, it will be seen that the total new members qualified was 2,217, an increase of 216 over the corresponding period in the previous year. The membership, not including Student members, is divided as follows:

Membership Grade	Per Cent
Honorary	0.04
Fellows	3.93
Members	27.47
Six-Year Associates	29.29
Associates	39.27
	100.00

The Member and Associate Grades have increased 0.44 per cent and 0.48 per cent, respectively, while the six-year Associate grade has decreased 0.90 per cent.

From Table VII, it will be noted that the number of applications from the Student members is once more ascending and that the applications from all other sources increased by 274 or 12.7 per cent. The total increase in applications was 333 or 13.7 per cent. No direct comparison between this Table and Table VIII can be made, since all applications received during the

Table VI. Membership Statistics for Fiscal Year Ending April 30, 1946

	Honorary Members	Fellows	Members	6-Year Associates	Associates	Subtotals	Totals
Membership April 30, 1945	6	914	6,238	6,963	8,951		23,072
Additions							
New members qualified		2	262		1,953	2,217	
Former members reinstated or re-elected		1	134	80	186	401	
Subtotals		3	396	80	2,139	2,618	
Transfers	3	90	466	925		1,484	
Totals	3	93	862	1,005	2,139	4,102	
Deductions							
Died		16	51	45	15	127	
Resigned			30	90	36	156	
Dropped			38	107	172	317	
Subtotals		16	119	242	223	600	
Transfers		3	89	378	1,014	1,484	
Totals		19	208	620	1,237	2,084	
Net changes	3	74	654	385	902	2,018	
Membership April 30, 1946	9	988	6,892	7,348	9,853		25,090

Table VII. Number of Applications Received From Student Members and From All Others

Year Ending April 30	Students	All Others	Total
1946	308	2,453	2,761
1945	249	2,179	2,428
1944	466	1,908	2,374
1943	783	1,431	2,214
1942	971	1,031	2,002

Table VIII. Number of Student Members as of April 30

Year	New Applications	Renewals	Total
1946	2,574	2,513	5,087
1945	2,326	2,287	4,613
1944	2,242	2,656	4,898
1943	2,512	3,200	5,712
1942	2,585	3,377	5,962

fiscal year are not acted upon before the close of that year.

Table VIII shows a marked renewed activity in Student membership. The increase in new applications is 248 while the increase in renewals is 226, bringing the total increase to 474. The Student membership now stands at 5,087.

Table IX is a record of the total membership of the Institute by years since 1884 and is given for information purposes.

Table X is the usual listing of the names of AIEE members reported in *Electrical Engineering* as having died during the fiscal year 1945–46. By this method a ready reference is provided.

The new booklet which was reported last year as being under preparation by the membership committee for use particularly when contacting prospects for membership in the Institute has been completed. It is an attractive, brief, concise publication of handy pocket size which already has been enthusiastically received.

There is much in the data relative to membership activity which should be of considerable interest to every person in the Institute. The growth has exceeded all expectations. It seems to be due to a strong interest on the part of the members generally, the enthusiastic co-operation of the entire membership committee personnel and the ever ready progressive co-operation of the members of the staff at the Institute headquarters. Undoubtedly, also the present economic situation and probable future trends in the scientific and industrial world are factors which have contributed to this rather unusual growth.

Table IX. Record of AIEE Membership

Year	Total May 1	Year	Total May 1	Year	Total May 1
1884	71	1905	3,460	1926	18,158
1885	209	1906	3,870	1927	18,344
1886	250	1907	4,521	1928	18,265
1887	314	1908	5,674	1929	18,133
1889	333	1909	6,400	1930	18,003
1890	427	1910	6,681	1931	18,334
1891	541	1911	7,117	1932	17,550
1892	615	1912	7,459	1933	17,019
1893	673	1913	7,654	1934	15,230
1894	800	1914	7,876	1935	14,269
1895	944	1915	8,054	1936	14,600
1896	1,035	1916	8,202	1937	15,308
1897	1,073	1917	8,710	1938	16,078
1898	1,098	1918	9,282	1939	16,605
1899	1,133	1919	10,352	1940	17,213
1900	1,183	1920	11,345	1941	17,886
1901	1,260	1921	13,215	1942	18,944
1902	1,549	1922	14,263	1943	20,161
1903	2,229	1923	15,298	1944	21,407
1904	3,027	1924	16,455	1945	23,072
		1925	17,319	1946	25,090

Table X. Deaths of AIEE Members Reported in "Electrical Engineering"

Name	Date of Election	Date of Death	Grade at Death	Obituary Notice in "Electrical Engineering"
Acres, H. G.	A '08	Sept. 4, '45	M	Oct. '45, p. 373
Adams, H. H.	A '06	Jan. 31, '45	M	May '45, p. 197
Alliason, A. R.	A '32	June 5, '45	M	Sept. '45, p. 337
Angle, F. C.	A '38	Oct. 25, '45	A	Jan. '46, p. 41
Barger, C. A.	A '44	Apr. 2, '45	A	July '45, p. 274
Barney, G. C.	M '37	May 11, '45	M	July '45, p. 274
Battit, B. E.	A '35	Oct. 11, '44	A	Nov. '45, p. 415
Beall, C. R.	A '18	Feb. 24, '45	A	June '45, p. 232
Bell, A. C.	A '01		A	June '45, p. 232
Bingham, A. R.	A '07	Jan. 4, '46	M	Mar. '46, p. 136
Blickley, C. F.	M '44	Nov. 11, '45	M	Jan. '46, p. 40
Blumberg, Ralph Dietz	M '44	Oct. 30, '45	M	Jan. '46, p. 40
Bolsterli, A. A.	A '23	Sept. 25, '45	M	Dec. '45, p. 459
Bonine, J. H.	A '17	May 12, '45	A	Aug. '45, p. 306
Booth, Wm. S.	A '44	May 3, '45	A	July '45, p. 275
Brewster, Truman P.	M '44	Jan. 7, '45	M	July '45, p. 275
Brown, Harry C.	A '20	Feb. 21, '45	A	July '45, p. 274
Brubaker, Leonard H.	A '42	Sept. 30, '45	A	Jan. '46, p. 40
Buehner, Robert O.	M '36	July 23, '45	F	Nov. '45, p. 415
Caldwell, C. W.	A '32	June 5, '45	A	Aug. '45, p. 306
Chatham, Clyde L.	A '25	June 7, '45	M	Sept. '45, p. 338
Clarkson, A. J.	M '26	June 4, '45	F	Aug. '45, p. 306
Conwell, R. N.	A '15	Apr. 14, '45	F	May '45, p. 197
Corson, Wm. R. C.	A '93	Oct. 2, '45	A	Dec. '45, p. 459
Creese, M.	A '07	Oct. 16, '45	M	Nov. '45, p. 415
Cushing, H. M.	A '06	Jan. 31, '45	F	May '45, p. 197
Davis, John M.	A '34	Aug. 13, '45	A	Oct. '45, p. 373
Donovan, J. D.	A '39	Dec. 20, '44	A	June '45, p. 232
Dudley, A. M.	A '08	Aug. 16, '45	F	Oct. '45, p. 373
Dyer, Leslie L.	A '10	Aug. 24, '45	M	Dec. '45, p. 458
Enfield, W. L.	A '10	Mar. 21, '45	F	May '45, p. 198
Faucett, Irving T.	A '11	Jan. 16, '46	F	Apr. '46, p. 179
Flowers, Alan Estis	M '04	Dec. '45	M	Jan. '46, p. 40
Fowle, F. F.	A '02	Jan. 21, '46	M	Mar. '46, p. 135
Frank, Harry C.	M '41	June 9, '45	M	Sept. '45, p. 338
Gabay, Henry R.	A '07	Jan. 12, '46	M	Feb. '46, p. 90
Gossler, P. G.	A '94	May 18, '45	F	July '45, p. 273
Haddow, A. B.	M '35		M	June '45, p. 232
Hanson, C. F.	A '18	Apr. 27, '45	M	Aug. '45, p. 306
Harvey, R. R.	A '95	Feb. 20, '45	A	July '45, p. 275
Hedges, Leo B.	A '28	Nov. 30, '45	M	Feb. '46, p. 90
Herman, J. W.	A '07	Mar. 30, '45	A	May '45, p. 197
Hertz, Adolph	A '18	May 31, '45	A	Aug. '45, p. 306
Highfield, John S.	F '42	Aug. 15, '45	F	Oct. '45, p. 373
Hill, Warren Rhodes	A '24	Apr. 11, '45	A	July '45, p. 274
Hoeckstetter, Lionel	A '35	May 8, '45	A	July '45, p. 274
Holder, Edward	A '13	Dec. 20, '45	M	Mar. '45, p. 136
Holslag, C. J.	M '19	June 11, '45	F	July '45, p. 273
Horrell, C. R.	A '16	July 5, '45	M	Aug. '45, p. 306
Horton, Bryson D.	A '14	Dec. 14, '45	A	Feb. '46, p. 90
Hutchinson, George E.	A '11	Oct. 20, '45	M	Dec. '45, p. 459
Ilsley, Lee Clyde	A '14	Nov. 23, '45	A	Jan. '46, p. 40
Jackson, Frederick D.	M '42	Dec. 18, '45	M	Feb. '46, p. 90
Kahler, Chas. Porterfield	A '10	Feb. 25, '46	M	Apr. '46, p. 180
Kahn, M. L.	A '20	July 25, '45	A	Oct. '45, p. 373
Karr, E. P.	A '40	Jan. 6, '45	A	Aug. '45, p. 306
Kelly, Walter Stuart	M '04	July 4, '45	A	Jan. '46, p. 40
Laidlaw, H. A.	A '09	Dec. 15, '45	M	Mar. '46, p. 135
Lindquist, D. L.	A '04	Nov. 11, '45	A	May '45, p. 198
Lovejoy, Jesse R.	A '91	Oct. 31, '45	F	Dec. '45, p. 459
Lowther, C. M.	A '00	Apr. 12, '45	A	July '45, p. 274
MacDonald, W. P.	M '43	Nov. 30, '45	A	Feb. '46, p. 90
MacLaren, Malcolm	A '05	Sept. 25, '45	M	Nov. '45, p. 415
Mason, E. J. K.	A '07	Feb. 23, '45	A	May '45, p. 198
McCormick, B. T.	A '04	Apr. 20, '45	F	July '45, p. 273
McElroy, D. W.	A '19	Dec. 13, '45	A	Jan. '46, p. 41
Moore, Leonard J.	A '15	June 4, '45	F	Sept. '45, p. 337
Myler, P. J.	A '07	Apr. 20, '45	A	June '45, p. 232
Neiler, S. G.	A '94	Feb. 28, '45	F	May '45, p. 198
Palmer, H. R.	A '08	June 16, '45	M	Aug. '45, p. 306
Patton, G. J. K.	A '39	Aug. 17, '45	A	Jan. '46, p. 41
Pease, H. C.	A '03	May 5, '45	A	July '45, p. 274
Pedersen, P. R.	A '23	Apr. 4, '45	A	Nov. '45, p. 415
Perkins, Chas. A.	A '05	Nov. 26, '45	F	Jan. '46, p. 40
Perry, Chas. L.	A '03	Nov. 20, '45	A	Feb. '46, p. 91
Petrasek, Wm. August	A '36	Jan. 31, '46	A	Mar. '46, p. 136
Poole, W. C.	M '39	Oct. 16, '45	M	Sept. '45, p. 337
Potts, L. M.	A '02	Oct. 23, '45	M	Jan. '46, p. 39
Price, C. A.	A '19	Dec. 29, '45	M	Mar. '46, p. 136
Pullen, M. W.	A '07	Jan. 10, '46	M	Mar. '46, p. 136
Putman, H. V.	A '23	Jan. 16, '46	M	Mar. '46, p. 136
Reinicker, N. G.	M '18	Jan. 13, '46	M	Feb. '46, p. 90
Rhodes, W. K.	A '09	Dec. 12, '45	M	Jan. '46, p. 41
Richards, A. F. W.	A '17	Jan. 25, '46	M	Mar. '46, p. 136
Ross, L. E.	A '29	Dec. 22, '45	A	Apr. '46, p. 180
Rowe, B. P.	A '03	Sept. 21, '45	F	Dec. '45, p. 459
Spaulding, S. A.	A '05	May 25, '45	F	July '45, p. 274
Symbolie, A. J.	A '42	Apr. '45	A	July '45, p. 275
Thomas, Wilbur Cover	A '24	Feb. 27, '46	M	Apr. '46, p. 180
Van Slyck, C. H.	A '03	Dec. 31, '45	A	Feb. '46, p. 90
Vincent, Wm. G.	A '05	Jan. 29, '46	A	Mar. '46, p. 135
Voorhees, W. N.	A '10	Jan. 18, '46	A	Mar. '46, p. 136
Waddell, C. E.	A '02	Apr. 20, '45	F	June '45, p. 232
Wallace, John Napier	M '14	Nov. 4, '45	F	Apr. '46, p. 179
Ward, B. D.	A '45	Jan. 18, '46	A	Mar. '46, p. 135
Westman, A. A. J.	A '07	June 22, '45	M	Sept. '45, p. 338

BOARD OF EXAMINERS

Statistics relating to the number of cases handled are given in Table XI. Members of the board have attended the scheduled monthly meetings very regularly, and the volume of work has justified fully the increased number of members which was arranged early in the season 1945–46.

The board wishes to reiterate its recommendation that local Section membership and transfer committees shall exercise more care in submitting applications, to insure that they are in line with constitutional requirements and particularly that they shall contain extensive and detailed experience records of the candidates which will reveal the degree of responsibility these candidates have had in connection with their various assignments.

It has been noted that an excessive amount of time has been consumed by the members of the board of examiners in interpreting the records of the candidates, and in too many cases applications have had to be returned for additional information, which in its opinion places an undue burden on the headquarters office.

Table XI. Applications for Admission and Transfer*

Applications for Admission		
Recommended for grade of Associate	1,464	
Re-elected to the grade of Associate	129	
Not recommended	8	
		1,601
Recommended for grade of Member	334	
Re-elected to grade of Member	23	
Not recommended	65	
		422
Recommended for grade of Fellow	2	
Re-elected to the grade of Fellow	0	
Not recommended	0	
		2
Applications for Transfer		
Recommended for grade of Member	450	
Not recommended for grade of Member	28	
		478
Recommended for grade of Fellow	90	
Not recommended for grade of Fellow	4	
		94
Students		
Recommended for enrollment as Students		1,568
Total		4,165

* This tabulation does not include April 1946 meeting figures.

COMMITTEE ON TRANSFERS

The members of the committee on transfers have co-operated actively during the year with the many Section officers and transfer committees of the Institute, explaining the requirements of the several grades of membership, and the required qualifications for transfer from Associate to Member and from Member to Fellow.

During the present year there have been a large number of transfers from the grade of Associate to Member and from Member to Fellow throughout all parts of the United States and Canada served by the AIEE.

COMMITTEE ON MEMBERS-FOR-LIFE FUND

Members-for-life awards, namely, expenses of District Branch paper prize winners to the summer convention of the Institute, will be made this year for the first time in connection with the Detroit meeting.

Last November, Secretary Henline invited the attention of the vice-presidents of the even-numbered Districts to the availability of these awards as described in *Electrical Engineering* for January 1945, page 31.

It will be recalled that this form of award financed by the income from the members-for-life fund, is on trial for two years—for even-numbered Districts this year and for odd-numbered Districts next year. The interest shown in this form of award this year and next year will determine whether or not it will be continued.

COMMITTEE ON CODE OF PRINCIPLES OF PROFESSIONAL CONDUCT

This committee held no formal meetings during the year but carried on its activities by correspondence. Various members of the committee have been active in their geographical areas and local engineering societies in bringing to the attention of engineers and others the Institute's code of principles of professional conduct and in advancing the Engineers Council for Professional Development canons of ethics for engineers.

One case of alleged violation of professional ethics by an Associate of the Institute has been brought to the attention of the committee and is still under consideration.

COMMITTEE ON CONSTITUTION AND BYLAWS

On January 4, 1946, the committee on constitution and bylaws made the following recommendations to the board of directors:

1. An amendment to Section 48 of the bylaws changing the basis of allotting funds to the Sections in order to conform with the action of the board on November 2, 1944.

2. An amendment to Section 65 of the bylaws, adding the name of a new committee on industrial control devices to the list of technical committees.

3. Changes in the bylaws transferring the Mexico Section from District 3 to District 7.

4. The word "national" to be deleted from the bylaws whenever it occurs in connection with the titles of officers, committees, and meetings. This was in line with similar action taken last year in eliminating the word "national" from the titles of officers, committees, and meetings wherever it occurred in the constitution.

On March 13, the committee recommended an amendment to Section 51 of the bylaws to make the definition of a "university or technical school of recognized standing" consistent with our present-day practice of accrediting engineering schools by the ECPD.

Recent action by the board of directors brings two more amendments to the committee for consideration. It is hoped that these can be presented to the board and action taken before the close of this administrative year. They are:

1. To amend the list of standing committees to include a committee on registration of engineers to succeed the present special committee of that name.

2. To amend the bylaws to provide for holding four conventions each year instead of the present practice of three per year, the new meeting to be known as the "midwest convention."

COMMITTEE ON PLANNING AND CO-ORDINATION

The project of reviewing the technical activities of the Institute and the Institute's relations with other organizations, which was assigned to the committee, is being carried out by the technical activities subcommittee and the professional activities subcommittee. These subcommittees are studying the problems to recommend any changes in organization or methods that may seem desirable to render the structure and the procedures of the Institute sufficiently flexible and adaptable to take account of progress in the art and the development of new fields of interest, and to respond promptly to changing social, political, economic, and other conditions affecting the welfare of society and of engineers.

A conference on Institute activities was conducted by the subcommittees on Wednesday, January 23, at the winter convention, as a first step toward finding out what the members believe the Institute should be doing or should do in a different way. The technical part of the discussion included suggestions for regional meetings on specific subjects and reorganizing the technical committee structure to form semiautonomous technical divisions to foster and correlate technical activities in related subject fields. During the professional activities part of the conference, four proposed plans for organizing the engineering profession were presented and discussed. Opinions were expressed on many phases of the organization problem including collective bargaining and unionization of engineers.

The technical activities subcommittee is also a working group of the technical program committee and thus accomplishes many of its projects through this committee. This close interrelation results in co-ordinated consideration of technical activity and organization matters.

The executive committee approved and referred to the committee on constitution and bylaws the recommendation of the subcommittee and the technical program committee that an annual Midwest Convention be held. Other joint projects are described in the technical program committee's report.

The professional activities subcommittee has arranged for representatives to participate in discussions of Institute activities at Section meetings in Boston, Lynn, Pittsfield, and New York; and at District meetings as follows: the North Eastern in Buffalo, N. Y., the Southern in Asheville, N. C., and the South West in San Antonio, Tex.

The problem of organizing the engineering profession is one of the main interests of the subcommittee. A questionnaire has been prepared to obtain the opinions of members who attend the meetings where the matter is discussed. The four proposed plans for organization of the engineering profession originally presented at the winter convention have been revised and

published in *Electrical Engineering* and are now available as a reprint.

The executive committee approved a recommendation originated by the subcommittee to replace the special committee on registration of engineers by a standing committee. A draft of the scope and duties for this committee was submitted as requested by the board of directors. A recommendation for forming joint Student Branches also was approved by the board of directors and referred to the committee on Student Branches with the suggestion that the latter work with representatives of other societies in developing a specific plan of co-operation.

A study is under way as to how to relieve the president of some of the burden of his office.

The subcommittee is endeavoring to find out what the problems and needs of the younger engineer-employees are, and what the Institute can do to get and keep their interest.

COMMITTEE ON SAFETY

The committee held one meeting during the past year, at the winter convention.

Through arrangements with the American Medical Association the paper by Doctor C. K. Drinker on "Use of Drugs in Resuscitation from Electric Shock" was published in the *Journal* of the American Medical Association, June 30, 1945. This paper which had been presented at the committee's meeting in January 1945, also appeared in *Electrical Engineering*, August 1945.

Under the heading "Safety Topics" in the January 1946 issue of *Electrical Engineering*, the committee directed attention of Institute members to the importance of safety engineering work in the postwar period as set forth in the National Safety Council publication, "Industrial Safety Tomorrow."

At the January 1946 meeting, the committee again emphasized the importance of promoting safety engineering work in the Student Branches and Sections, and formulated plans for appropriate communications to the Student Branch counselors and Section officers.

Report was received from the Institute's representatives on the electrical committee of the National Fire Protection Association concerning the adoption in Chicago during October 1945 of revisions of the National Electrical Code, of which the 1946 edition is expected to be issued before the end of this year.

The committee contemplates resumption of its work with the AIEE committee on domestic and commercial applications on the study of electrical hazards to farm animals, which had been started and had to be deferred because of war conditions.

The attention of the committee was directed to the report on fatalities in the electric light and power industry during the year 1944 as prepared by the Edison Electric Institute accident prevention committee. Over the past four years, an average of 81 per cent of the fatalities in that industry have been shown to be due to electric shock and burn, and the committee recognizes the importance of steps being taken to stress the fundamentals of this matter in appropriate ways for the benefit of Institute members concerned.

Plans were completed for a session under the auspices of the committee during the 1946 summer convention, and there was discussion of important subjects in the field of electrical safety, on which it is planned to have papers prepared or other appropriate presentations made for discussion at the forthcoming national meetings.

W. T. Rogers was appointed to serve as liaison representative of the committee with the American Society of Safety Engineers, and W. R. Smith will continue to serve in such capacity with the accident prevention committee of the Edison Electric Institute.

UNITED STATES NATIONAL COMMITTEE OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION

During the past year, as in the preceding war years, the work of the International Electrotechnical Commission and the United States National Committee has remained virtually in a state of suspension.

At its annual meeting on November 9, 1945, the United States National Committee re-elected E. C. Crittenden, president; L. F. Adams, vice-president; and H. S. Osborne, vice-president and treasurer.

Looking toward the reactivation of IEC work, appointments of several new technical advisers were made. Considerable interest has been expressed in the international work on letter symbols, USNC 25, and, upon recommendation of the three new technical advisers for USNC 25, the United States National Committee took action at its meeting to authorize the circulation for comment in this country and to other national committees of a draft of the IEC symbols which had been adopted in 1938, together with additions prepared by a subcommittee authorized in 1938. The USNC has acted as secretariat for this work.

During the year, the French committee requested comments on their proposals for standardization of very high voltages. The matter was referred to the technical adviser for the USNC (USNC 8) on the subject, and while no report was available, it was hoped that an answer to the French proposals could be made soon. The United Nations Standards Co-ordinating Committee was very hopeful that action could be taken on this matter, since a number of the European countries, particularly France, which were faced with rebuilding their power systems, were anxious to rebuild the systems using standard voltages.

At the USNC annual meeting, there was a discussion of reorganization of international standardization work. The United Nations Standards Co-ordinating Committee had just concluded meetings in New York and had drafted a proposed constitution for an international organization. A proposal has been made that the IEC become affiliated with the new organization and operate officially in the future as the electrical division of the new organization, retaining, however, all its functions and procedures. A subcommittee of the executive council of the UNSC was appointed to study from the point of view of the USNC the proposals for the method of affiliation of the IEC with the new organization.

It is now expected that a meeting of the council of the IEC will be held during 1946 and that the technical work of the commission will be resumed shortly thereafter. Many countries, particularly those in Europe, are anxious that IEC work be resumed, in order that some of the problems arising from reconstruction work may be solved by the IEC.

Standards

STANDARDS COMMITTEE

During the past year, the work of the Standards committee continued to be hampered by the restrictions which still existed with regard to traveling and to hotel accommodations. The curtailment, however, has been confined largely to a limitation of the number of meetings held, of which there were three. The various committees carrying on standardization activities have continued to make satisfactory progress by correspondence, although that procedure also has suffered recently through the strikes in progress in the larger industrial groups.

The various technical committees which now carry on much of the preliminary work in the development of new standards projects, as well as any required revisions of existing standards, have reported a large number of new projects in preparation, many almost ready for action. Among these may be listed the following: test code for resistance measurement; test code for temperature measurement; standard method of calculating the short-circuit currents in low-voltage circuits; standards for roof, floor, and wall bushings and for potheads; and standards for mercury-arc rectifiers. Under the auspices of the standards co-ordinating committees, the following projects also have been reported as well under way: standard barometric pressure and air density versus altitude; guiding principles for dielectric tests; letter symbols for electrical quantities; temperature rises for silicone insulation; and standard voltages from 100 to 15 kv.

In the field of electric aeronautical equipment, the standardization carried on by the Institute and other interested organizations is going forward, although curtailed in some of its phases by the changeover from wartime activities.

The following projects were approved and published during the year: AIEE Standard 45 "Recommended Practice for Electric Installations on Shipboard"; Numbers 601 and 602, "Preferred Standards and Standards Specification Data for Large 3,600-Rpm 3-Phase 60-Cycle Condensing Steam Turbine Generators"; Number 503 "Test Code for Synchronous Machines"; ASA Standard C37.4 to C37.9, "A-C Power Circuit Breakers."

As a result of the many reorganizations brought about by the end of the war, it has been necessary to make a large number of new appointments of AIEE representatives serving on various sectional committees of ASA.

The electrical definitions project, under the auspices of sectional committee C42 and the sponsorship of the Institute, inactive since publication of the first edition of the American Standard in 1942, now is being reorganized. While the addition of a large number of new definitions has been suggested, the criticisms of existing definitions have been few. On completion of the main committee personnel, the reorganization of the 18 or more subcommittees will be undertaken and all suggestions referred to them for inclusion in a new edition.

The subcommittee on applications of statistical methods has pursued an active program during the year. The educational articles which appear in *Electrical Engineering* will conclude with XII. The subcommittee then proposed to prepare and publish at least six more articles of a more advanced character.

A very successful conference was held during the winter convention in New York, and similar conferences have been arranged for the Buffalo and Detroit meetings. At the latter meeting the theme will be the management and organizational aspects of quality control. It is hoped that a conference also can be arranged at all of the remaining district meetings during 1946.

Technical Committees

COMMITTEE ON AIR TRANSPORTATION

The proceedings of the committee on air transportation during the past year were greatly handicapped by extensive reconversion of industry, shifting of personnel, and the ban on meetings and traveling. In spite of these obstacles, good progress was made in the standardization activities assigned to the committee.

These activities were carried on by several subcommittees, four of which were formed during the previous year, with assignments as outlined in the report for last year.

Aircraft Electric Systems. This subcommittee has accumulated approximately one half of the material required to complete the proposed guide report on aircraft electric systems in accordance with the outline completed last year. Cooperation of interested aeronautical groups, including Aeronautical Radio, Inc., has been very good, after some initial misunderstandings were cleared up.

Aircraft Electric Rotating Machinery. This subcommittee met several times during the year, and at a meeting held January 22 completed the proposed test code for d-c aircraft motors, except for final editorial revision. Editorial revision has been assigned to a small working group, and it is anticipated that a final draft of the test code will be ready for submission in June.

Aircraft Electric Control and Protective Devices. This subcommittee will be unable to complete its assignment until the guide report on systems and the work on cables has been more nearly completed.

Aircraft Wire and Cable. This subcommittee has sponsored manufacturers' tests on AN-16 and AN-8 aircraft cables and has extended the data to cover the complete range of sizes from AN-22 to AN-00. Tentative recommendations for extreme ratings of cables have been prepared as a technical paper, "Short-Time Current Ratings for Aircraft Wire and Cable," by P. W. Jones and J. A. Scott. At present further action to be taken by this committee has not been determined, and the personnel on this committee has been especially affected by reconversion resulting from the end of the war. A possible course of action will be to issue the essential content of the Jones–Scott paper as a preliminary report for trial.

Two additional subcommittees were formed during the year:

Joint Subcommittee (Air Transportation and Electric Machinery) on Carbon Brushes. The assignment of this subcommittee was the formulation of an AIEE test code for the evaluation of carbon brush performance on all types of commutators and collector rings, so as to provide for improved specifications and standards for carbon brushes used on electric machinery.

Subcommittee for Altitude Ratings. This subcommittee has been assigned the task of developing an AIEE Standard outlining the basic principles of altitude rating on electric machinery. The work will be co-ordinated with that being done by AIEE standards co-ordinating committee 1 and with Section I-12 of AIEE Publication 1.

One committee meeting, held during the winter convention, was devoted largely to consideration of the standardization activities enumerated. There was considerable discussion of a proposal to undertake a study of safety considerations affecting the use of electric equipment on aircraft. The majority of the committee expressed a desire for a preliminary review to determine the propriety of such a study. There was a strong minority opinion that this study would not come within the assigned scope of the air transportation committee. Subsequent attempts to carry out the majority sentiment of the committee have met with little enthusiasm, and the entire project now appears to be more suitable for action by the Civil Aeronautics Authority rather than by the Institute.

The committee also decided that there would not be any need to establish a proposed subcommittee to be of concern with the problems of airline operators. It was felt that this subject could be handled satisfactorily within the new Air Transportation Association

During the year a total of 17 technical papers were sponsored by the committee. Seven of these were presented in two air transportation sessions at the winter convention, and the other papers were printed and circulated for written discussion in accordance with the Institute arrangement during the cessation of meetings.

COMMITTEE ON AUTOMATIC STATIONS

The members of this committee have continued their activities in bringing to the Institute papers dealing with subjects related to automatic stations and supervisory control. Several papers were presented during the year, and additional papers have been secured for future presentation.

Two meetings of the committee were held during the past year, one in October 1945, and one in January 1946. In addition to considering material for new papers, the committee completed its plans for conferences on automatic or supervisory control of air switches and automatic control of capacitors. Authors have been secured for papers for these conferences. Being mindful of the importance of joint co-operation with other committees, careful consideration has been given to the reports of our representatives on other committees and to the work being done by our members on several joint subcommittees.

During the past year, two working groups were organized and at present are engaged actively in their assignments. One of these groups is investigating the matter of the type of trip to be provided for circuit breakers with special reference to their application to automatic stations. The other group is looking into the correct polarity of d-c control for automatic stations. The work of these groups has been well begun but will not be completed during the present fiscal year.

COMMITTEE ON BASIC SCIENCES

The committee on basic sciences sponsored the symposium on nuclear energy at the winter convention, and has arranged for a session for the summer convention. During the war, the work of the committee fell off, but recently it has begun to approach its prewar level, and technical programs for future meetings appear more promising.

At a meeting of the committee held during the winter convention, there was a serious discussion of the place of basic science material in the AIEE meeting and publication programs. The committee thought there would be a gain in reversing the apparent tendency of recent years to have material handled by committees with specific fields rather than by the committee on basic sciences, and also thought that an over-all increase in basic science material was desirable. To this end an aggressive campaign is being started to expand the work of the committee. Results probably will not show for some time, but it is hoped that the contribution will be evident in expanded technical presentations of the committee at later dates. Concurrent with the extension of the committee's activities, a group of subcommittees, the existence of which was not warranted during the war, is to be instituted.

COMMITTEE ON COMMUNICATION

More than 40 papers on a wide variety of communications subjects were sponsored by the committee during the year.

In view of the cancellation of the summer and Pacific Coast technical meetings, some of these papers were made available in pamphlet form for discussion by mail in lieu of formal presentation. These included a comprehensive report on the

January 1945 conference on radio frequency cables made up of 17 papers on the general subjects of polyethylene insulation for high frequency cables, cable manufacture, cable design, and cable testing. In addition the summer and fall technical paper program (presented by mail) included papers on judging mica quality, optimum air gap for coils subject to direct current, radio noise meter calibration and methods for measuring the attenuation of coaxial cables.

At the winter convention in January of this year, there were five communications sessions as follows:

A General Communications session which included seven papers on a wide variety of subjects as follows: electronic regeneration of telegraph signals; two papers on filter design, one for telegraph and the other for broad band carrier; two papers on throat microphones covering design and methods of testing; the solution of transmission line problems; applications of thin permalloy tape in wide band transformers, a technique which should be of interest to many as the field of wide band transmission expands.

Two Sessions on Radar which were arranged in cooperation with the committee on electronics. These sessions provided a well-rounded coverage of the radar field. The six papers presented related to general principles, two typical wartime uses of radar, two proposed peacetime uses, on ships and airplanes, and a comprehensive coverage of radar testing techniques. The latter paper should be of interest to many outside the radar field, since many of these techniques will be useful in the expanding fields of high frequency transmission and electronics.

A Session on Sound Recording and Reproducing which included eight papers on various recording media such as tape, wire, and disks. There is a growing interest in wire recording, and this was well covered by four papers relating to the general principles, a specific design of a recorder head, means for measuring the magnetic characteristics of recording wire and signal and noise levels encountered in tape recording. Two papers were presented on disk recording, one of them relating to a new reproducer design and the other to new tools for the study of disk recording performance. The growing importance of recording in business was brought out by a paper on this subject.

A Conference on Slow Acting Relays which included four prearranged talks by engineers active in this field. These covered the historical aspects, underlying electromagnetic concepts, operational features, and limitations of relays in power communication. It is planned to explore this field further with the thought of ultimately making available published material for the benefit of the entire membership.

Meetings of the committee on communication were held in June, October, and January. Indicative of the broad scope of the activities of the committee are the following subcommittees which now are functioning: sound recording and reproducing, slow acting relays, hearing aids, testing of telephone transmitters and receivers, power line carrier, underwater sound developments. These subcommittees have been active in arranging for papers in their fields, many of which were presented at the last winter convention. In the coming year, it is proposed to increase the committee activities in the field of television.

The committee has co-operated with the other technical committees wherever the subject matter was of joint interest. This is illustrated by the joint sponsorship with the committee on electronics of the papers on radar and also by the appointment of the chairman of the subcommittee on power line carrier as the committee representative on the joint subcommittee on power system applications of carrier current.

Emphasis has been placed on making available the results of the committee's activities to the entire Institute membership rather than only to the few who can attend national meetings. Substantially all of the talks presented at the various national technical meetings have been or will be published in *Electrical Engineering* or in *Transactions*. A report on the conference on high frequency cables was made available in pamphlet form, and the entire membership was notified of its availability. Also outstanding papers presented at District meetings are being recommended for publication, so that the entire membership can benefit from these papers which would otherwise be heard by only a few.

COMMITTEE ON EDUCATION

The committee on education shares with the Society for the promotion of Engineering Education and ECPD an interest in the guidance and selection of students and their proper professional education in colleges and universities offering accredited curricula in electrical engineering. It has the opportunity of co-operating with many groups within the AIEE organization to further the education of the electrical engineer, both before and after his graduation from college—indeed, to make education a continuing process in the life of each AIEE member. Its relationship to the committee on Student Branches is necessarily close. In promoting educational work in the AIEE Sections throughout the country, it works with the Sections committee. The publication of general technical articles which start from basic principles and bring the reader up to date on a particular device requires co-operation with the editor of *Electrical Engineering*.

Every year many suggestions for educational activities on the part of the Institute are received by the committee and tabled because: other agencies for the objective are already in existence, lack of funds, or inappropriateness. This year, for example, the committee did not act favorably on a proposal to establish an agency at AIEE headquarters to counsel returning veterans as to educational preparation for electrical engineering, nor did it feel that a proposal to set up a series of correspondence courses of a refresher type or on new developments in electrical engineering for returning veterans and reconverted war industry workers was feasible.

As an aid to schools teaching electrical engineering during the past year, the committee collected information on the teaching of electronics as a service course to students with a background of physics, other than electrical engineering students and has in preparation a summary of the practices reported as successful.

At the 1946 winter convention, the committee organized a session devoted to a comparison of the achievements of electrical engineering graduates in civilian war research agencies as compared with men who were professional physicists. This meeting and the full report of it published in *Electrical Engineering* may have helped considerably in clearing up a confused situation which might have done harm had it long continued.

In keeping in touch with developments in electrical engineering curricular changes, the committee has not taken any stand on their merits. The five-year program leading to the bachelor's degree has been discussed, and the experiment encouraged, with the thought that the results be reported, evaluated, and disseminated to all schools.

The place of electronics in the postwar electrical engineering curriculum will be the subject of a conference at the 1946 summer convention.

In co-operation with the committee on Student Branches, a revision of the AIEE guidance pamphlet, "The Electrical Engineer," is now in preparation, as the first edition nearly has been exhausted.

An exploration of the possibilities of standardization of laboratory equipment for schools in order to reduce costs is being undertaken.

Advisory services to Sections of the Institute contemplating the establishment of educational courses have been rendered and a joint letter sent out by the chairman of the Sections committee on this topic.

Steps are being taken to secure a new series of articles for publication in *Electrical Engineering* similar in general to those published ten years ago, which will bring AIEE members up to date on the newer developments in our field, particularly in fundamentals, written for the ordinary engineer and free of unnecessary mathematical obfuscation.

The project to revise and bring up to date the committee's list of film strips and motion pictures has been held up by unsettled conditions, but it is hoped some progress on this may have been made by the end of the year.

COMMITTEE ON ELECTRIC WELDING

A meeting of the committee was held January 21, 1946, during the winter convention. Papers for the summer convention and for the 1947 winter convention were discussed. The work being done by the technical activities subcommittee and the professional activities subcommittee was reviewed. Considerable interest was shown in the activities of these two subcommittees, and several suggestions were made which were passed on to the subcommittee affected.

There were no activities of this committee on standards, although it is understood that revision for peacetime use of war Standard C52.4, C52.5, and Z49.1 will be started in the near future. Representatives of this committee will assist in this work.

One technical session was sponsored by the committee at the winter convention. Four technical papers were presented. Two of the papers were on arc welding subjects, and the other two were on resistance welding. Two technical sessions are being sponsored at the summer convention. Three technical papers and one

conference paper are to be presented on resistance welding subjects, and three conference papers on arc welding subjects.

COMMITTEE ON ELECTROCHEMISTRY AND ELECTROMETALLURGY

The activities of the committee on electrochemistry and electrometallurgy during the past year have been confined largely to subcommittee work. No sessions or conferences have been sponsored at any of the national or District meetings. A meeting of the committee was held in New York, January 24, 1946, at which the work of the subcommittee was reviewed and plans formulated for future activities.

The subcommittee on metallic rectifiers, under the chairmanship of Doctor L. O. Grondahl, is actively at work on the following projects:

(*a*). Preparation of a test code.

(*b*). Preparation of a list of nomenclature and symbols.

(*c*). Preparation of a bibliography on metallic rectifiers.

Preparation of the bibliography is nearing completion, and excellent progress is being made on the test code and nomenclature. A group to consider the preparation of standards also is contemplated. Four meetings a year are planned by this subcommittee. The first was held in New York, January 25, 1946, and the second is scheduled to be held April 25, during the North Eastern District meeting in Buffalo.

The subcommittee on voltage transients in arc furnace circuits of which Doctor E. R. Whitehead is chairman, held a meeting in New York on January 23, 1946. Doctor Whitehead presented a report on the 1945 trouble record for arc furnace customers on the Duquesne Light Company System. Among 29 customers having 44 arc furnace installations, there were 18 reported cases of trouble. Of the 18 cases of trouble, possibly three, and probably one, were caused by overvoltage.

In a discussion of the most fruitful course of future action, S. B. Griscom suggested that the subcommittee prepare a brief report outlining preferred practice in arc furnace installations. It was pointed out that such a report would not be considered a standard and that similar guides had proved very useful in other fields. A preliminary outline of subjects to be considered was drawn up, and a working group has been appointed to prepare a first draft before June 1.

The subcommittee urges all who may have test data, or any information on this subject not included in the 1944 report, to assist in this work, either by the preparation of an appropriate technical paper or by submitting it to the committee for discussion.

The committee on electrochemistry and electrometallurgy also is represented on the joint subcommittee on induction and dielectric heating.

COMMITTEE ON ELECTRONICS

The subcommittee plan of operation is employed for the work of this committee. A meeting of subcommittee chairmen was held in October 1945, and another in April 1946, both in New York. A meeting of the entire committee was held during the winter convention.

Subcommittee activities have been as follows.

1. Electronic Power Converters Subcommittee. This group has during the past year completed two tasks that have been in process for several years, and represent the result of a great deal of effort on the part of each of many subcommittee members.

The first of these is a draft of "Standards for Pool Cathode Mercury-Arc Power Converters," which is now in the hands of the standards committee. Copies of this draft will be distributed broadly to encourage early use of the proposed Standards. It is planned to publish a review of these Standards in *Electrical Engineering* at an early date, and to provide an opportunity for discussing them at the summer convention.

The second of these two completed tasks is a report on "Inductive Co-ordination Aspects of Rectifier Installations." It is planned to present this for discussion during the summer convention, and to publish it in *Electrical Engineering* and the *Transactions*.

Work on a bibliography covering electronic power converters is approaching completion. Tasks that lie ahead for this subcommittee are the preparation of standards for electronic power converters employing hot cathode tubes and standards for electronic power converters used with electronic motors.

2. Subcommittee on Nomenclature, Definitions, and Symbols. This group has completed the preparation of an extensive set of proposed standard definitions, which are being channelled through the standards committee for adoption. An important aspect of this work has been co-ordination with a similar IRE activity. Additional work is in progress extending the coverage of the standards proposals to additional subject matter.

3. Technical Papers Subcommittee. This subcommittee generally has encouraged and solicited the preparation of technical papers on electronic subjects. The policy of distributing available papers on electronics to other committees which sponsor sessions covering the applicational subjects involved has been continued. The technical paper coverage of electronic subject matter has been in general satisfactory.

This subcommittee organized and conducted a very successful informal technical conference at the winter convention. The subject was "New Industrial Uses of Electronics Resulting from Wartime Developments." Additional similar future programs are being planned.

In response to a request for help in carrying on the work of technical groups affiliated with local Sections, manufacturers of radio and electronic equipment were canvassed for movie films, lecturers, bulletins, educational courses, and the like, and the material so collected was correlated and distributed to local Sections.

4. Subcommittee on Electronic Heating. By means of approximately monthly meetings throughout the winter and spring, this subcommittee has been very active in the difficult work of promoting co-ordination of electronic heating practices with Federal Communication Commission's frequency allocations and radiation field strength limitations. This group also has given attention to safety practices and equipment rating standards.

5. Electron Tube Subcommittee. This group has undertaken a program of gas tube standardization work in close co-operation with a parallel group in the IRE.

6. Liaison Subcommittee Activities. There is a general need for improving the co-ordination between technical activities in electronics of the AIEE committee and certain parallel activities of the IRE and related activities of the Joint Electron Tube Engineering Council (JETEC), also for effective contact with the AIEE Standards committee and the American Standards Association. To this end, there have been established, under the committee on electronics, a subcommittee on JETEC liaison and tube standards, a subcommittee on AIEE-IRE liaison, which has become active in discussions toward standardization of frequency-band nomenclature, and a subcommittee on electronic standards. These subcommittees have been active in various technical and co-ordination problems.

7. Other Subcommittees. Subcommittees on electronic precipitation, electronic control, electronic welding, X-ray tubes, and on wires and cables, have been active in their respective fields. The committee on electronics thinks that one of its important responsibilities is to serve as a continuing co-ordinating agency between the various professional organizations in the electronics and technical workers in various differing applicational fields where the use of electronic devices is important.

COMMITTEE ON INDUSTRIAL CONTROL DEVICES

This new committee was organized in the fall of 1945. Three meetings have been held. The first, or organizing meeting, was held in Milwaukee on November 7, 1945, and the second meeting was held in New York on January 21, 1946, during the winter convention. The third meeting was held in Cleveland on April 11, 1946, and a fourth meeting is scheduled to take place in Detroit during the coming summer convention.

Considerable discussion has dealt with the scope of this new committee in its relation to other committees of the Institute. In order to pursue its work, the following subcommittees and working groups have been set up:

1. Subcommittee on industrial electronic control. This subcommittee will work in co-operation with a subcommittee of the committee on electronics.

2. Subcommittee on revision of AIEE–ASA Standards 15.

3. Subcommittee on test codes for industrial control devices.

4. Subcommittee on servomechanisms.

5. Liaison with American Society for Testing Materials.

6. A working group on bibliography on industrial control.

A number of papers have been reviewed in preparation for presentation at coming Institute conventions.

COMMITTEE ON INDUSTRIAL POWER APPLICATIONS

Owing to conditions prevailing last year, this committee carried on practically no work after the winter convention of January 1945 until the present committee was formed last September.

At the January 1945 meeting, a series of papers and very interesting discussions on the subject of industrial voltage requirements were presented, although the subject was found to be too broad to reach any conclusions at one session.

When the present committee took up the work last September, it decided to form two subcommittees, one to study again the subject of industrial voltage requirements, and the other to review the field of machine and process drives.

At the winter convention, in January 1946, the committee sponsored three sessions, two covering chiefly the industrial voltage subject, and one on co-ordinated drives in industrial processes.

The two sessions on industrial voltage requirements were held on the same day, and a committee luncheon meeting was held between the two sessions.

At the first session, an interim report on the subject of industrial voltage requirements was presented, and was very well received. A number of good suggestions were received from the discussion from the floor. Therefore, the subcommittee is at present actively working and hoping to present a completed report on this subject in the near future for review by the board of directors.

The committee luncheon was attended by 22 members of the committee and the major topic of discussion was a continuance of the subject industrial voltage requirements. It was the concensus that this subcommittee should continue the work and have a final report available at the earliest possible date.

The second session, held in the afternoon of the same day, was sponsored jointly by the committee and the inductive heating subcommittee. Two papers were given on subjects allied to industrial voltage requirements and two papers on inductive heating.

The third session was under the auspices of the subcommittee on machine and process drives. A general report outlining the proposed scope of this subcommittee was presented, and the discussions from the floor suggested that the work of this committee should stress the increasing importance of co-ordinated drives in industrial processes.

Two papers were presented on allied subjects which were well received, and committee members expressed a desire for more papers along the lines of the two that had been given which furnished technical and practical application data on co-ordinated drives.

This subcommittee held a meeting in March, when it was agreed by the membership that better results might be obtained by sponsoring papers for a particular industry at two or three of the main technical meetings throughout the year and by ultimately assembling the best of the papers presented into a report form. It was agreed that at the next main technical meeting the subcommittee would have available a series of papers covering the textile industry.

The committee members, both at the winter convention and at the various subcommittee meetings, have agreed to try to cultivate the interest of the industrial groups of all sections of the Institute. By this means we are hoping to build a closer tie between the national committee and the various industrial groups, thereby creating greater interest throughout the membership of industrial problems.

COMMITTEE ON INSTRUMENTS AND MEASUREMENTS

With the cessation of hostilities, the committee on instruments and measurements resumed many activities curtailed during the war and has undertaken a number of new projects. Two meetings of the committee were held in New York, one November 14, 1945, and the other April 10, 1946.

Although no technical meeting was held during the summer, the committee reviewed a considerable number of technical papers, and four were included on the summer technical program. Gyroscope testing, resistance thermometers, lag of thermometer elements, and current transformers were subjects of the papers. At the winter convention in January 1946, seven papers were presented in two sessions under the sponsorship of the committee. The papers covered a wide range of instrument and measurement applications, including stress measurement, servomechanisms, surge-current measurement, high-speed recording, thermal demand meters, and automatic oscillography The sessions were well attended, and a great deal of interest was shown in the papers. Through the year a number of papers reviewed by the committee were included on the programs of District or Section meetings. Three sessions under sole sponsorship of the committee or joint sponsorship with other committees are planned for the next summer convention.

Through its 14 subcommittees, the committee has been active in standardization matters. Preliminary drafts of master test codes for resistance measurement and for temperature measurement have been prepared, and now are being considered for approval by the main committee. A proposed final draft of the revision of a former report on a proposed Standard 40, on recording instruments, is nearing completion and is expected to be ready for recommendation as a new standard in the next few months. Recommended changes in and additions to the "American Standard Definitions of Electrical Terms" are under preparation and will be offered as suggestions for a future revision of that Standard. A revision of the 1941 AIEE report on "Telemetering, Supervisory Control and Associated Circuits" is being undertaken by the joint subcommittee on that subject.

In co-operation with the corresponding subcommittees of the ASA sectional committee C-57, and of the committee on protective devices, the subcommittee on instrument transformers has carried forward the work on the instrument-transformer definitions to be included in the ASA Standard on transformers. A request of the committee on instruments and measurements that the section of this standard dealing with instrument transformers be separated editorially from the complete standard has received favorable consideration by the ASA committee, and the subcommittee on instrument transformers plans to carry out the editorial work necessary to make the separate publication possible.

The field of servomechanisms has received particular attention during the past year, and the subcommittee on that subject has been active in stimulating papers on servomechanisms and in sponsoring, jointly with the corresponding subcommittee of the committee on industrial control devices, a session on servomechanisms at the coming summer convention.

Because of the growing importance of electronic instruments in a wide variety of instrument and measurement applications a joint subcommittee on electronic instruments has been formed through co-operative action by the committees on instruments and measurements and on electronics. This subcommittee is engaged actively in stimulating papers and discussion on electronic instruments for a conference at the summer convention

COMMITTEE ON MARINE TRANSPORTATION

The printed revision of Standard 45 became available during February 1946 as the 1945 revision of the Standard.

It was considered inadvisable to hold meetings of the committee until the printed revision was available. Therefore, no meetings were held during latter part of 1945.

Two all-day meetings of the committee were held during 1946, and it is proposed to have one more all-day meeting before the close of the administrative year. Discussions at these meetings cover preparation of proposed changes and additions applicable to future revisions of Standard 45.

The committee believes that future revisions of Standard 45 should include complete recommendations covering a-c installations. This action is deemed advisable because of the increased use of a-c distribution systems on ships together with the greatly increased number of electrically propelled vessels.

There have been no changes in the personnel of the committee except the addition of one AIEE member, a British electrical engineer, prominently identified in similar activities in British Institution of Electrical Engineers. It is believed that this addition to our membership will make for closer relations between American and British shipboard electrical practices.

COMMITTEE ON POWER GENERATION

In spite of rather severe handicaps imposed by the war and by the subsequent dislocations, the first year of the activities of the committee on power generation, while operating with the newly appointed and expanded subcommittees, proved to be quite successful. The response of the membership to the plans and efforts of the committee has been very satisfactory, and there is every indication that the committee will continue to grow in its importance.

The specific activities of the committee during the past year may be summarized as follows:

Central Station Auxiliaries. The material of the previously held technical conference on the subject of central station auxiliaries had been rewritten in the form of five technical papers, subjected to the regular review and grading, and finally published as a part of the 1945 fall technical paper program. The comments and discussions received since the publication indicated that this activity served a timely and useful function.

Hydroelectric Systems. It has been realized for some time that the problems of the design and operation of hydroelectric systems did not receive sufficient attention in the technical activities of the AIEE, as compared with their importance in the electrical picture in this country. Under the sponsorship of a newly appointed subcommittee, a thorough canvass was made of the potential interest and possible material pertaining to this topic.

The initial session on hydroelectric systems was held during the 1946 winter convention in New York, with the presentation of two technical papers and three conference papers. There was evidence of a strong interest on the subject especially among AIEE Canadian membership. Present plans call for the continuation of this activity with a sponsorship of similar sessions at the summer convention in Detroit, at the winter convention in New York, and possibly at the Pacific Coast convention.

Excitation Systems. Another new activity of the committee, originated this year and introduced to the membership with a symposium of six papers at the 1946 winter convention, was the subject of excitation systems. The excellent attendance of the session and the widespread discussion of the topic indicated that this activity also meets a real need and that it should be continued. Accordingly, the subcommittee made plans for further contributions at the summer and winter conventions. Work is in progress to formulate definitions and terms used in discussions of excitation systems.

Prime-Mover Governing. The present activities of this subcommittee are:

1. A revision of AIEE 600 relating to speed governing specifications for steam turbine generators.
2. The preparation of a specification for the speed governing of hydro turbine generators.
3. The preparation of two additional specifications for types of steam turbine generators not covered under AIEE 600.

The probability is that all work in progress will be completed and submitted to the standards committee for approval by the spring or summer of 1947.

COMMITTEE ON POWER TRANSMISSION AND DISTRIBUTION

A full meeting of the committee was held at the winter convention. A report was made by a subcommittee consisting of the officers and chairmen of subcommittees on possible reorganization of committees. The only change proposed and approved by the main committee was to change the three working groups under the transmission subcommittee to full subcommittees to be known as lightning and insulator subcommittee; towers, poles, and conductors subcommittee; and insulated wire and cable subcommittee. The change will take place at the beginning of the next administrative year.

Technical Meetings. At the winter convention, the committee sponsored one technical meeting. A report of the lightning and insulator working group on the "Lightning Performance of 220-Kv Lines—Part II" was made. Other papers dealt with economics of transmission, arcing grounds on 13-kv, 3-phase busses, and inductance of square busses.

Subcommittee Activities. The distribution subcommittee has a joint project with the relay subcommittee of the committee on protective devices through a working group composed of members of both subcommittees. This group is studying plans for improvement in the quality of service on overhead distribution circuits. Also a study is being made of proper forms for reporting the troubles on distribution circuits to obtain better evaluation of the effects of different construction practices and protective devices. The group has had one meeting and plans another during the summer convention. The subcommittee is canvassing its members for possible papers for the winter convention in 1947. This subcommittee has under consideration the following subjects: (*a*) design of systems for fluctuating loads; (*b*) 4 versus 13 kv distribution economics; (*c*) network supply from two sources; (*d*) nonleaded cables in the earth.

The stations subcommittee held one meeting and has arranged for papers to be presented at a session during the summer convention.

The transmission subcommittee, through the working group on lightning and insulators, presented its report on the questionnaire on lightning performance of 190 to 287-kv lines by means of a paper at the winter convention in January 1946. This group is now preparing a second volume of the "Lightning Reference Book" to cover the period from 1935 to 1945 inclusive. This working group has under consideration the following projects: (*a*) the predetermination of lightning performance of transmission lines as a guide to the design of such lines; (*b*) a questionnaire on the record of outages on high voltage lines from all causes; and (*c*) a survey of the performance of insulators, wood and air in series, and possibly a further investigation of the subject. It is expected to have two papers available for the summer convention dealing with ceramic dielectrics at elevated temperatures and co-ordination of insulation and spacing of transmission line conductors.

The cable working group has interchanged correspondence on the beginning of a study to investigate the proper methods for evaluating the effect of the thermal properties of buried cable systems of the direct burial and duct types. The group has been actively soliciting papers, so that it is expected to have six papers at a cable session to be held at the summer convention. There are also prospects for about five papers at the winter convention in 1947. The working group on towers, poles, and conductors has been endeavoring to get papers on the comparison of wood and steel in structures and on the preservative treatment of wood. There is a possibility of one paper for the summer convention.

The general systems subcommittee is studying a standard method of evaluating power losses, which it is hoped will result in two papers. The subcommittee is still studying stability of transmission lines, which study will continue for another year or two. The subcommittee is following the development of d-c transmission both in Europe and in the United States. The subject of overvoltages on transmission lines is under consideration by the subcommittee.

It is intended to have a meeting of the full committee during the summer convention in Detroit. The committee is sponsoring two sessions at this convention.

COMMITTEE ON PROTECTIVE DEVICES

Principally because of the wide variety of fields included in the scope of the committee, an attempt was made this year to place more of the responsibility for the preparation of Standards and other specific activities in the hands of the subcommittees rather than attempt to cover too many of these details in the main committee. The subcommittees have reacted favorably to this increased responsibility, and, with a few more adjustments necessitated by this change in operating concept, they should be able to function very satisfactorily.

The committee sponsored 13 papers for the winter convention and expects to have about 8 on the schedule for the summer program. A special working group has been set up to solicit papers by operating engineers. It is thought that particularly in the postwar period a review of operating experiences can be of major assistance to

the manufacturers in formulating plans for new designs and new products. It is recommended that this activity be continued at least for the coming year.

There have been two meetings of the main committee and another is scheduled at the time of the summer convention in Detroit. The subcommittees have met more frequently, and their accomplishments outlined in more detail follow.

Circuit Breakers and Assembled Switchgear. The work of the subcommittee was handled mainly through six working groups, each of which was assigned a specific project.

The working group on the "Air Circuit Breaker Standard 20" completed the work on the proposed Standards and have referred it to the committee for further action.

The working group on "Switchgear Assembly Standard 27" reviewed the standard in its present form and decided that no further action should be taken this year.

The working group on the proposed standards for automatic circuit reclosers for a-c distribution circuits sent out drafts of the proposed standards at two different times. Adverse comments were received on both drafts, and the project will require further action by both the working group and the subcommittee. For this purpose, it is planned to hold a joint subcommittee and working group meeting in Pittsburgh on May 16. It is hoped that at that time the differences of opinion which have prevented passing of the standards can be cleared and that the standard can be presented to the committee for final action before closing the current year's business.

The working group on studying short-circuit current for low voltage circuits has held several meetings, but was unable to complete its work until more test data could be obtained and examined. Their work is not expected to be completed this year.

The working group on "Power Circuit Breaker Standard 19," which was assigned the additional problem of studying the method of defining interrupting ratings, reports satisfactory progress, but states that its project cannot be completed during the current year. No revision of Standard 19 is recommended at this time.

The working group on technical program papers by operating engineers has worked diligently to obtain papers covering operating experiences. The reward for its interest has been slight and not all that was hoped for.

It is recommended that the work of the group on the method of defining interrupting rating should be continued into the succeeding year or until it is completed. The matter of technical program papers by operating engineers should be an item for continuing study. Although the results obtained have not been very satisfactory, it is believed that the interest of the Institute demands that study of the subject should be continued until satisfactory results are obtained.

Lightning Protective Devices. "Expulsion Type Distribution Lightning Arresters, AIEE Standard 47," December 1945, was sponsored by H. L. Stewart, New England Power Service Company. His working group completed the Standard except for editorial changes during 1945. The Standard was issued for trial use December 1945. The project has been completed.

"Industry Survey of Performance Characteristics of Distribution Expulsion Type Lightning Arresters" was sponsored by E. W. Beck, Westinghouse Electric Corporation, East Pittsburgh, Pa. Mr. Beck appointed a working group and secured data from all manufacturers of these arresters, worked up a first draft of the report, then submitted it to the group for comments. Comments and new data were received which required a new draft. The new draft will be submitted to the working group for approval when completed, after which it will be sent to the subcommittee for approval and publication in *Electrical Engineering*. It is suggested that this project be continued to completion under the sponsorship of Mr. Beck.

"Survey of Lightning Protective Equipment Used on A-C Rotating Machines" was sponsored by T. H. Mawson, Commonwealth and Southern Corp., Birmingham, Ala. Mr. Mawson prepared a questionnaire which was sent to major utilities. Complete returns are not in. It is suggested that this project be continued under the sponsorship of Mr. Mawson.

"Lightning Protection for Substation Units" has been sponsored by E. R. Whitehead, Duquesne Light Company, Pittsburgh, Pa. Mr. Whitehead appointed a working group and set up the following procedure:

(*a*). To formulate the problem more definitely.

(*b*). To contact the transformer subcommittee with a view to having them co-operate in this study.

(*c*). To consult with manufacturers to get their views on the protection needed in the problem.

It is suggested that this project be continued under Mr. Whitehead's sponsorship.

Combination of the three Lightning Arrester Standards, AIEE 28, 47, and 24 was sponsored by F. M. Defandorf, National Bureau of Standards, Washington, D. C. He appointed a working group and has issued a second draft which is now in the hands of the working group for comments. Mr. Defandorf has made an excellent start on this project and is doing a splendid job. It is therefore suggested that this project be continued under his sponsorship. This is a major standard and may require several years to complete, as there is considerable revising to be made in the test sections which require new information.

The subject of surge protection for arc furnaces was discussed by the committee. Mr. Whitehead, chairman of the subcommittee on overvoltages in arc furnace circuits, was asked to serve as the contact between the two committees and offer the assistance of the lightning protective devices subcommittee. No working project has been set up for this subject, as the need for such a group has not crystallized.

Fault Limiting Devices. This subcommittee has had three active working groups on present-day grounding practices; revision of "Standard 32, Neutral Grounding Devices"; and "Bibliography Concerning System Grounding." This latter group was formed January 23, 1946. The series capacitor protective device has been assigned to this subcommittee, and one paper on this subject was presented at the January meeting. The subcommittee will be prepared to sponsor standards in connection with these devices if necessary.

Relays. Two meetings of the relay subcommittee were held, one in Cleveland, October 18, 1945, and one in New York, January 21, 1946. Another meeting of the subcommittee to summarize the activity of the year will be held in Cleveland, May 16.

As in recent years, the work of the subcommittee has been carried forward principally by a number of working groups, to each of which has been assigned a particular project.

A working group on the bibliography of protective relaying has been continued, and has prepared a bibliography of technical articles on relaying for 1945. The sponsor of this group is again C. E. Parks. The bibliography for 1945 was distributed not only to the members of the subcommittee, but also to the relay subcommittee mailing list, a list prepared by the subcommittee of approximately 100 engineers who are most vitally interested in relaying problems. As this bibliography is now kept up to date year by year, it will be a simple matter to publish the accumulated bibliography for a period of three or four years, whenever it becomes desirable. It is recommended that the work of this group be continued.

A working group under the chairmanship of J. C. Bowman has continued to study the protection of generators against winding failures. It is anticipated that this group will prepare a report on recommended practices for relay protection of generators, which should be published when completed. The activity of this group should be continued until a report is published.

The working group on current transformers with low-current secondary windings has been continuing, but S. C. Leyland has taken over the sponsorship. A report covering various applications justifying the use of current transformers having a rated secondary current of less than 5 amperes is being completed, and it is hoped that this report can be presented at the summer convention in 1946.

The activity of the working group on the protection of power house auxiliaries, sponsored by E. L. Michelson, is drawing to a close, and the report of this work, including recommended practices, will be presented at the summer convention in 1946. A preliminary report was presented for discussion at a conference on relaying problems held at the winter convention of the AIEE in January. The work of this group should be complete this year.

The working group on the co-ordination of transformer protection, organized last

year, has continued to study these problems, with W. R. Brownlee as sponsor. A preliminary report and a conference paper on the work of this group were presented at the conference session on relaying problems at the winter convention, and the discussion provided additional material for work of the group. It is expected that a final report can be prepared for the winter convention in 1947, and the group should be continued until the report is presented.

The group on standards for instrument transformers for relaying purposes has been continued under the sponsorship of C. A. Woods. The principal activity of this group, which consisted in assisting subcommittee 4 of ASA committee C57 to revise the American Standards for instrument transformers, has been completed, but some additional work on guides for operation and the test code for instrument transformers has remained for further consideration. This group should continue to stand by until all details of the revision of ASA C57 have been completed, but no further extensive activity is contemplated in the near future.

A joint working group with the committee on power transmission and distribution was appointed last year to study the correlation of construction and protection of distribution circuits, with George Dodds as sponsor. Because of the joint sponsorship, some delay was experienced in completing the organization of this group, but activity is continuing, and the first meeting of the entire group was held in Pittsburgh, March 20. The activity of this group should continue throughout the next year and should result in a valuable report on distribution circuit problems.

During the year a working group was appointed to carry out the revision of ASA Standards for protective relays, under the sponsorship of J. H. Oliver. Because of man power limitations, this group has not yet been very active, but has been studying the problem, so that when man power is available the work can proceed rapidly. The activity of this group is being co-ordinated with the corresponding subcommittee of ASA committee C37 on power switchgear, so that the completed draft of the proposed revision may be acceptable without extensive change as the ASA Standard. The work of this group should continue until the new standard is accepted and published.

A working group under the sponsorship of H. R. Paxson has been investigating the problem of grounding instrument transformer secondaries. A considerable divergence of practice was found, and it appears desirable that a report on this subject should be presented to the Institute. Possibly this report may be ready for the summer convention in 1946, but in any case it should be ready by the time of the winter convention in 1947.

COMMITTEE ON APPLICATIONS OF ELECTRICITY TO THERAPEUTICS

This committee held one meeting during the year. At this meeting, the following general principles were considered.

There are three factors in the application of electricity to human beings:

(*a*). The effect, if any, on man.

(*b*). The safe limits of dosage, and the measurement of the same.

(*c*). Methods of protecting the operator.

The following applications were considered.

1. About high frequency of heating, it was the general opinion of the committee that workers could be shielded from high frequency fields by interposing metal barriers. There is no information available as to the amount of heating to which a human being could be subjected without injury.
2. It was brought to the attention of the committee that some of the ultrahigh frequencies used in radar produced a certain amount of X-ray radiation. Most of this is believed to be in the soft X-ray field. It is claimed, however, that some very hard X-rays may be produced. The committee has suggested that a study be made and the amount of X-ray radiation produced by different radar sets be investigated.
3. The effect of sun lamps and ultraviolet-ray radiation lamps also was discussed. A few individuals are believed to be supersensitive to such radiation. The Westinghouse Electric Corporation volunteered to furnish equipment and lamps and to help in carrying out a study of the amount of ultraviolet radiation. The School of Hygiene at the Johns Hopkins University was suggested as a possible location for carrying on this investigation. It has been notified of the project, and it is under consideration.
4. Doctor Rentschler of the Westinghouse Electric Corporation called attention to a special short wave lamp and its successful use in treating infected wounds. He reported that certain deep-seated wounds which had not responded to sulpha treatments had healed rapidly when exposed to rays from the lamp.

Awards

INSTITUTE PRIZES

In May 1945, the committee on award of Institute prizes reported the award of three national prizes, after consideration of all eligible papers in the several classifications for prize awards and solicitation of the recommendations of the chairmen of the technical committees relative to the best papers in specialized fields. As usual, the choice between leading papers worthy of award in the several classes of prizes was very close. The committee gratefully acknowledged the assistance of the technical committees and their reviewers in nominating and grading the many papers eligible for the awards. Owing to the wartime situation, no papers were submitted for the national prize for Branch paper.

SPECIAL COMMITTEE TO REVIEW PRACTICES IN THE AWARD OF INSTITUTE PRIZES

The committee has prepared and submitted to the board of directors a proposed revised practice covering the award of Institute prizes. The suggested practices were determined after reviews with various interested committees and the vice-presidents representing the Districts. Questions related to prize award practices of the Sections have been raised by the chairman of the Sections committee, and the special committee requested that action by the board be postponed pending further consideration of the Section problem now being undertaken by the Sections committee.

EDISON MEDAL

The Edison Medal, awarded by a committee composed of 24 members of the Institute, was presented for 1945 to Philip Sporn, executive vice-president, American Gas and Electric Service Corporation, New York, "for his contributions to the art of economical and dependable power generation and transmission." The presentation took place January 23, 1946, during the winter convention. The medal may be awarded annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts."

LAMME MEDAL

The Lamme Medal committee awarded the medal for 1945 to David C. Prince, vice-president, general engineering and consulting laboratory, General Electric Company, Schenectady, N. Y., and past president of the Institute. Arrangements are being made for the presentation of the medal at the annual business meeting in Detroit, June 26, 1946. The medal may be awarded annually to a member of the AIEE "who has shown meritorious achievement in the development of electric apparatus or machinery."

HOOVER MEDAL

The Hoover Medal was established through a trust fund created by a gift from Conrad N. Lauer and is to be awarded periodically "to a fellow engineer for distinguished public service" by a board representing the ASCE, American Institute of Mining and Metallurgical Engineers, ASME, and AIEE. The seventh medal, for 1945, was awarded to Doctor William H. Harrison, vice-president, American Telephone and Telegraph Company, New York, and was presented to him on January 23, 1946, during the AIEE winter convention.

JOHN FRITZ MEDAL

The John Fritz Medal board of award is composed of representatives of the ASCE, AIME, ASME, and AIEE. The medal may be awarded annually for notable scientific or industrial achievements. The 1946 medal was awarded to Doctor Zay Jeffries, vice-president in charge of chemical department, General Electric Company, Pittsfield, Mass.

WASHINGTON AWARD

The Washington Award for 1946 was bestowed upon Doctor Vannevar Bush, president of the Carnegie Institution of

Washington (D. C.), and director, Office of Scientific Research and Development. The presentation was made at a dinner in Chicago, Ill., in February. The award may be made annually to an engineer by the commission of award composed of nine representatives of the Western Society of Engineers and two each of the ASCE, AIME, ASME, and AIEE.

ALFRED NOBLE PRIZE

This prize, established in 1929, consists of a certificate and a cash award from the income of a fund contributed by engineers and others to perpetuate the name and achievements of Alfred Noble, past president of the ASCE, and of the Western Society of Engineers. It may be made to a member of any of the co-operating societies, ASCE, AIME, ASME, AIEE, or WSE, for a technical paper of particular merit accepted by the publication committee of any of these societies, provided the author, at the time of such acceptance, is not over 30 years of age. The award for 1945 was presented, in January 1946, to A. L. Ahlf, a member of the ASCE, for his paper, "Design Constants for Beams with Nonsymmetrical Straight Haunches."

CHARLES LE GEYT FORTESCUE FELLOWSHIP

No fellowship has been awarded this year on account of the fact that there are so few graduate students in the colleges at this time. Sufficient funds are available to consider the granting of fellowship awards, totaling about $1,000 per year. It is expected that as soon as there are a reasonable number of graduate students in the colleges, notices will be sent out offering this fellowship.

Joint Activities

UNITED ENGINEERING TRUSTEES, INC.

This organization manages property and funds held jointly by the four founder societies, including the Engineering Societies Building, the Engineering Societies Library, and the endowment funds of the Engineering Foundation.

The building is occupied fully by engineering organizations, and additional space is needed both for offices and for meetings. Therefore, there has been a renewal of planning for the future adequate housing for engineering societies.

The founder societies have been requested to report fully upon their present and estimated future needs for space. A committee of the UET is endeavoring to develop tentative plans for the remodeling of the building or the procurement of a new building to meet the needs of the founder societies and, if possible, bring in other engineering societies.

Increased revenue from meeting halls and close attention to expenditures produced a small credit balance for the year ended September 30, 1945.

An abstract of the annual report for the year ended September 30, 1945, appeared in *Electrical Engineering*, January 1946, page 47.

ENGINEERING FOUNDATION

The Engineering Foundation was established in 1914 as a joint organization of the four societies, ASCE, AIME, ASME, and AIEE, for "the furtherance of research in science and engineering, and the advancement in any other manner of the profession of engineering and the good of mankind."

Each research project supported by it is under the sponsorship of one of the founder societies.

During the year, the Welding Research Council continued work on nine projects and inititated two new projects. The council is sponsored by the founder societies, the American Welding Society, and the Society of Naval Architects and Marine Engineers. Its work is carried on by eight research committees.

Other reserach projects supported by the Foundation include soil mechanics, columns, alloys of iron, metal cutting, plastic flow of metals, and strength of metals.

The Foundation has continued to support the work of the ECPD.

An abstract of the annual report for the year ended September 30, 1945, appeared in *Electrical Engineering*, January 1946, pages 48–9.

ENGINEERING SOCIETIES LIBRARY

The Engineering Societies Library was formed by combining the separate libraries of the ASCE, AIME, ASME, AIEE, and preparing a composite card catalogue.

Special services rendered by the library include: photoprints, searches, abstracts, translations, bibliographies, book loans by mail.

Wartime conditions prevented the usual growth in the book collection and greatly increased the demand for photostat prints and for other services.

An abstract of the annual report for the year ended September 30, 1945, appeared in *Electrical Engineering*, January 1946, page 49.

EMPLOYMENT SERVICE

Operating as an incorporated nonprofit organization, the Engineering Societies Personnel Service, Inc., assists members of the founder societies desiring to secure new positions and employers searching for engineers. Nonmembers may receive such assistance when positions available cannot be filled by members.

Offices are operated in New York; Detroit, Mich.; Chicago; and San Francisco, Calif.; with the co-operation of the Engineering Society of Detroit in that city, the Western Society of Engineers in Chicago, and the Engineers Club of San Francisco in that city.

For several years, the service has been on a self-supporting basis, but the prevailing scarcity of engineers available for new positions has reduced the number of placements. A record of registration and placements during the past year is given in Table XII.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

Organized in 1932 to engage in activities leading toward the enhancement of the professional status of the engineer, this council now includes three representatives of each of the eight participating organizations: the ASCE, AIEE, ASME, AIME, SPEE, American Institute of Chemical Engineers, National Council of State Boards of Engineering Examiners, and the Engineering Institute of Canada.

During the past year, as in previous wartime years, inspections of engineering curricula by the committee on engineering schools were held to a minimum. Twenty-six curricula in 13 institutions were inspected during the past three years. Complete regional personnel for the accrediting of technical institute curricula has been organized.

Other activities are carried on by committees whose titles indicate the nature of their work: student selection and guidance, professional training, professional recognition, information, engineering ethics, employment conditions for engineers, and ways and means.

A comprehensive report on the activities during the year ended September 30, 1945, was published in *Electrical Engineering*, December 1945, pages 461–2.

ENGINEERS JOINT COUNCIL

This Council, formerly known as the joint conference committee, is composed of the presidents, immediate past presi-

Table XII. Analysis of Employment Service

	Men Registered					Men Placed				
Month	New York	Chicago	San Francisco	Detroit	Total	New York	Chicago	San Francisco	Detroit	Total
1945										
May	101	24	40	30	195	17	8	19	10	54
June	98	30	36	24	188	20	9	24	6	59
July	92	28	37	24	181	27	20	20	9	76
August	141	54	53	39	287	20	15	15	9	59
September	242	88	92	57	479	27	25	19	8	79
October	329	79	124	73	605	35	12	20	13	80
November	226	97	113	55	491	43	20	22	11	96
December	202	67	100	43	412	36	16	20	11	83
1946										
January	338	106	134	49	627	42	27	25	13	107
February	251	86	126	60	523	28	18	19	9	74
March	296	79	182	81	638	34	18	20	13	85
April	246	98	113	65	522	43	20	24	20	107
Total	2,562	836	1,550	600	5,148	372	208	247	132	959

dents, and secretaries of the founder societies and the AIChE. Its functions are to consider matters of interest to the societies and to make recommendations to their governing bodies.

A panel was organized to advise a Senate committee regarding research legislation, and a joint committee on technological personnel in relation to national security was established.

Major projects have been started on industrial disarmament of aggressor states, economic status of the engineer, and organization of the engineering profession.

REPRESENTATIVES

A complete list of about 40 joint bodies upon which the Institute is represented appears in the Year Book and in the September issue of *Electrical Engineering* each year.

Appreciation

The board of directors expresses its deepest appreciation and thanks to the committees, and the District, Section, and Branch officers, and the members in general in grateful recognition of the many expansions in activities and the continuing rapid increase in membership.

Respectfully submitted for the board of directors.

H. H. HENLINE
Secretary

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Securities Owned, April 30, 1946

Schedule 1

	Principal Amount of Bonds or Number of Shares of Stock	Restricted Funds: Reserve Capital Fund	Life Membership Fund	International Electrical Congress Library Fund	Lamme Medal Fund	Total
Railroad Bonds:						
Atlantic Coast Line first consolidated 4%, due 1952	$ 4,000.00				$4,253.78	$ 4,253.78
Baltimore & Ohio, Pittsburgh, Lake Erie & West Virginia System 4%, due 1951	10,000.00	$ 6,450.00				6,450.00
Chicago & Erie Railroad Company 5% first mortgage, due 1982, registered	1,000.00	1,105.00				1,105.00
New York Central Railroad Company 4% series A consolidated mortgage, due 1998	10,000.00	6,100.00				6,100.00
Northern Pacific Railway Company collateral trust 4½%, due 1975	10,000.00	10,325.00				10,325.00
St. Louis-San Francisco Railway Company 5% prior line mortgage series B, due 1950 (certificates of deposit), registered, stamped	6,000.00*	5,497.50*				5,497.50*
Total railroad bonds		$ 29,477.50			$4,253.78	$ 33,731.28
Public Utility Bonds:						
New York & Queens Electric Light & Power Company 3½% first and consolidated mortgage, due 1965	$10,000.00	$ 11,000.00				$ 11,000.00
United States Government Bonds:						
Treasury savings bonds series D, due July 1, 1949	10,000.00	$ 7,644.00				$ 7,644.00
Treasury savings bonds series D, due January 1, 1950	10,000.00	7,500.00				7,500.00
Treasury bonds 2%, due 1950/48	77,000.00	78,130.94				78,130.94
Treasury bonds 2%, due 1950/48, registered	3,000.00	3,060.94				3,060.94
Treasury bonds 2½%, due 1968/63	20,000.00	15,000.00	$5,000.00			20,000.00
Treasury bonds 2½%, due 1972/67	6,300.00	1,100.00		$5,200.00		6,300.00
Treasury bonds 2½%, due 1972/67, registered	3,500.00	3,516.41				3,516.41
Defense bonds series F, due June 1, 1953	34,000.00	25,160.00				25,160.00
Defense bonds series G 2½%, due December 1, 1954	18,000.00	18,000.00				18,000.00
Treasury savings bonds series G 2½%, due September 1, 1955	40,000.00	40,000.00				40,000.00
Treasury savings bonds series G 2½%, due November 1, 1956	17,000.00	17,000.00				17,000.00
Treasury savings bonds series G 2½%, due May 1, 1957	20,000.00	20,000.00				20,000.00
Treasury savings bonds series G 2½%, due October 1, 1957	30,000.00	30,000.00				30,000.00
Total United States Government bonds		$266,112.29	$5,000.00	$5,200.00		$276,312.29
Capital Stocks:						
American Can Company	60 shares	$ 4,988.40				$ 4,988.40
American Telephone & Telegraph Company	100 shares	17,454.15				17,454.15
Atchison, Topeka & Santa Fe Railway Company preferred	150 shares	13,035.46				13,035.46
Boston Edison Company	200 shares	4,927.50				4,927.50
Commonwealth Edison Company	200 shares	7,580.68				7,580.68
Consolidated Natural Gas Company	11 shares	221.92				221.92
Eastman Kodak Company	35 shares	4,768.23				4,768.23
E. I. du Pont de Nemours & Company	50 shares	7,982.07				7,982.07
General Electric Company	130 shares	4,463.80				4,463.80
General Motors Corporation $5 preferred	100 shares	12,785.00				12,785.00
General Motors Corporation	100 shares	4,235.53				4,235.53
International Harvester Company	100 shares	5,030.50				5,030.50
International Match Realization Company, Ltd. voting trust certificates for capital shares of International Match Corporation	6* shares	1,851.15*				1,851.15*
Louisville & Nashville Railroad Company	100 shares	6,278.13				6,278.13
Ohio Edison Company 4.40% preferred	150 shares	15,727.50				15,727.50
Pacific Gas and Electric Company	200 shares	8,784.35				8,784.35
Sears, Roebuck and Company	400† shares	6,014.97				6,014.97
Standard Oil Company of New Jersey	200 shares	9,601.26				9,601.26
Union Carbide & Carbon Corporation	100 shares	7,277.42				7,277.42
United Fruit Company	100 shares	11,985.00				11,985.00
United States Steel Corporation 7% cumulative preferred	100 shares	14,885.00				14,885.00
Total capital stocks		$169,878.02				$169,878.02
Total		$476,467.81	$5,000.00	$5,200.00	$4,253.78	$490,921.59
* Less reserve in full for securities considered to be of doubtful value		7,348.65				7,348.65
Total Securities, Less Reserve		$469,119.16	$5,000.00	$5,200.00	$4,253.78	$483,572.94

† Stock was split up in October 1945 by issuance of three additional shares for each one held.

HASKINS & SELLS
CERTIFIED PUBLIC ACCOUNTANTS

1 EAST 44TH STREET
NEW YORK 17

May 20, 1946

American Institute of Electrical Engineers,
33 West 39th Street, New York.

Dear Sirs:

We have examined the balance sheet of the American Institute of Electrical Engineers, and schedule of securities owned, as of April 30, 1946, and the related statements of cash receipts and disbursements of operating and restricted funds for the year ended that date, have reviewed the accounting procedures of the Institute, and have examined its accounting records and other evidence in support of such financial statements. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances and included all auditing procedures we considered necessary, which procedures were applied by tests to the extent we deemed appropriate in view of the system of internal control.

In our opinion, the accompanying balance sheet, schedule of securities owned, and statements of cash receipts and disbursements fairly present, respectively, the financial condition of, and securities owned by, the Institute as of April 30, 1946, and its recorded cash receipts and cash disbursements for the year ended that date, in conformity with generally accepted accounting principles and practices applied on a basis consistent with that of the preceding year.

Yours truly,

(*Signed*) HASKINS & SELLS

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Balance Sheet, April 30, 1946

Exhibit A.

ASSETS			LIABILITIES		
Property Fund Assets:			**Property Fund Reserve**		$ 548,407.13
One-fourth interest in physical properties of United Engineering Trustees, Inc.:			**Restricted Fund Reserves:**		
Land, buildings, and equipment (less depreciation and renewal reserve)	$361,880.00		Reserve capital fund	$505,795.19	
Funded depreciation and renewal reserve	136,568.48		Life membership fund	8,684.75	
Total	$498,448.48		Member for life fund	5,031.09	
Equipment			International Electrical Congress of St. Louis library fund	5,878.05	
Library (volumes and fixtures)—estimated value	36,366.37		Lamme Medal fund	4,440.44	
Office furniture and fixtures (less reserve for depreciation, $27,761.27)	9,978.02		Mailloux fund	1,137.83	
Works of art, etc.	3,001.35		Total restricted fund reserves		530,967.35
Cash (no change during year)	612.91		**Operating Fund Reserves, Liabilities, etc.:**		
Total property fund assets		$ 548,407.13	Accounts payable	$ 15,455.58	
Restricted Fund Assets:			Deferred income:		
Securities—at cost, less reserve, $7,348.65 (quoted market value, $552,893.92)—Schedule 1	$483,572.94		Dues received in advance	4,503.14	
Cash (Exhibit C)	47,304.66		Entrance fees and dues advanced by applicants for membership	1,263.45	
Accrued interest receivable	89.75		Subscriptions to publications received in advance	17,940.01	
Total restricted fund assets		530,967.35	Miscellaneous (including unallocated receipts)	1,315.67	
Operating Fund Assets:			Operating fund reserves	84,620.36	
Cash (not including $1,302.87 for Federal taxes withheld from employees)—(Exhibit B)	$ 81,379.47		Total operating fund reserves, liabilities, etc.		125,098.21
Accounts receivable:					
Members—for dues (less reserve, $4,000.00)	8,133.58				
Advertisers	5,667.40				
Miscellaneous	3,649.99				
Accrued interest receivable	5,735.52				
Inventories:					
Transactions, etc.	1,054.00				
"Electrical Definitions"	3,668.40				
Work in process (May issue of *Electrical Engineering*, etc.)	6,140.28				
Text and cover paper	7,299.52				
Badges	2,370.05				
Total operating fund assets		125,098.21			
Total		$1,204,472.69	Total		$1,204,472.69

Exhibit B. Statement of Cash Receipts and Disbursements of Operating Fund for the Year Ended April 30, 1946

Cash on Deposit With The National City Bank of New York, May 1, 1945 (not including $1,295.18 for Federal taxes withheld from employees)		$ 77,206.09
Receipts:		
Dues (including $127,602.00 allocated to *Electrical Engineering* subscriptions)	$271,620.45	
Advertising	130,875.11	
Transactions subscriptions	8,557.39	
Electrical Engineering subscriptions	26,158.51	
"Electrical Definitions"	887.95	
"Electric Power Distribution for Industrial Plants"	2,769.00	
Miscellaneous publications (preprints, Standards, *Electrical Engineering* supplement, etc.)	23,468.40	
Students' fees	11,659.50	
Entrance fees	19,793.42	
Membership badges	4,468.61	
Transfer fees	3,601.29	
Interest and dividends on investments of Restricted Capital fund	13,389.09	
Barstow bequest (including interest of $652.03)	10,652.03	
Miscellaneous	541.44	
Total receipts		528,442.19
Total		$605,648.28
Disbursements:		
Publications expense:		
Electrical Engineering	$122,603.60	
Transactions	13,964.43	
Year Book	7,993.83	
Miscellaneous publications (preprints, Standards, "Industrial Plants" report, *Electrical Engineering* supplement, etc.)	19,771.44	
Institute meetings	15,310.00	
Institute Sections	44,899.10	
Institute Branches	2,872.01	
Finance committee	600.00	
Headquarters committee	83.87	
Membership committee	10,434.07	
Standards committee	15,681.37	
Forward	$254,213.72	$605,648.28
Total (forward)		$605,648.28
Disbursements (forward)	$254,213.72	
Technical committee	947.15	
Committee on institute publicity	840.33	
Planning and co-ordinating committee	3,122.18	
Joint committee—Economic Status of the Engineer	8.73	
Engineers Joint Council	870.13	
American Society of Civil Engineers handbook	250.00	
Retirement system AIEE—normal contribution	4,982.72	
Canadian Radio Technical Planning Board	318.17	
Radio Technical Planning Board	500.00	
Traveling expenses:		
Geographical Districts:		
Executive committees	5,240.17	
Vice-presidents	1,027.62	
Branch counselors and chairmen	1,280.61	
President's appropriation	1,840.79	
AIEE representatives	289.70	
Board of directors	7,171.50	
Nominating committee	1,253.85	
Administrative expenses	63,658.00	
Geographical Districts—Branch paper prizes	163.64	
Institute prizes—national	309.06	
American Co-ordinating Committee on Corrosion	25.00	
American Standards Association	1,750.00	
United Engineering Trustees, Inc.:		
Building assessment	17,813.64	
Library assessment	11,377.85	
Engineers' Council for Professional Development	1,852.00	
Engineering Foundation Project—Welding research	250.00	
National Committee State Board Engineering Examiners	500.00	
John Fritz Medal	50.00	
National Fire Protection Association—Dues	60.00	
Membership badges	5,265.20	
Legal services	250.00	
Lamme Medal expense (see Exhibit C)	191.03	
Office furniture and fixtures, and repairs	339.13	
Edison Medal committee	115.90	
Transfers:		
To reserve capital fund:		
Barstow bequest	10,652.03	
Other	123,726.58	
To Member for Life fund	1,762.38	
Total disbursements		524,268.81
Cash on Deposit With The National City Bank of New York, April 30, 1946 (not including $1,302.87 for Federal taxes withheld from employees)		$ 81,379.47

Exhibit C. Statement of Cash Receipts and Disbursements of Restricted Funds for the Year Ended April 30, 1946

		Restricted Funds					
	Total	Reserve Capital Fund	Member for Life Fund	Life Membership Fund	International Electrical Congress of St. Louis Library Fund	Lamme Medal Fund	Mallioux Fund
Cash on Deposit With The National City Bank of New York and Various Savings Banks, May 1, 1945	$ 35,064.88	$ 26,586.40	$3,268.71	$3,380.79	$531.80	$176.22	$1,120.96
Receipts:							
Income from bonds	$ 415.00			$ 125.00	$130.00	$160.00	
Interest on bank balances	65.26			48.39			$ 16.87
Transfers for operating fund:							
Barstow bequest	10,652.03	$ 10,652.03					
Other	125,488.96	123,726.58	$1,762.38				
Life membership fees	678.80			678.80			
Liquidating dividend—International Match Realization Company, Ltd	24.00	24.00					
Total receipts	$137,324.05	$134,402.61	$1,762.38	$ 852.19	$130.00	$160.00	$ 16.87
Total	$172,388.93	$160,989.01	$5,031.09	$4,232.98	$661.80	$336.22	$1,137.83
Disbursements:							
Purchase of securities	$124,312.98	$124,312.98					
Transfer to operating fund	595.07			$ 595.07			
Purchase of medal, cost of engraving, etc. (exclusive of $191.03 paid from general fund)	176.22					$176.22	
Total disbursements	$125,084.27	$124,312.98		$ 595.07		$176.22	
Balance on Deposit With The National City Bank of New York and Various Savings Banks, April 30, 1946	$ 47,304.66	$ 36,676.03	$5,031.09	$3,637.91	$661.80	$160.00	$1,137.83

National and District Prize Awards for 1945 Announced

Recipients of the 1945 national prize awards for papers were announced by M. D. Hooven (F'44) chairman of the AIEE committee on award of Institute prizes at the annual meeting of the Institute, June 26, in Detroit, Mich. In the class of public relations and education the paper chosen was presented during the year 1944 when no award was made in that class. Owing to readjustments in the universities and colleges made necessary by the war, no papers were submitted for the national prize for Branch papers.

Each national prize award consists of an appropriately engrossed certificate and a check for $100 divided in the case of coauthors. The awards were as follows:

Best Paper in Engineering Practice. Prize awarded to James DeKiep (M'43) of the Electric Machinery Manufacturing Company, Minneapolis, Minn., and L. R. Hill and G. L. Moses (M'44) of the Westinghouse Electric Corporation, East Pittsburgh, Pa., for their paper, "The Application of Silicone Resins to Insulation for Electric Machinery," presented at the 1945 winter technical meeting, New York, N. Y., January 22–26, and published in the 1945 *Transactions*, pages 94–8. Honorable mention was awarded to L. J. Gorman (M'30) of the Consolidated Edison Company of New York, Inc., New York, N. Y., for his paper, "Electrolysis and Corrosion of Underground Power-System Cables," presented at the 1945 winter technical meeting, New York, N. Y., January 22–26, and published in the 1945 *Transactions*, pages 329–36.

Best Paper in Theory and Research. Prize awarded to G. D. McCann (M'44) and H. E. Criner of the Westinghouse Electric Corporation, East Pittsburgh, Pa., and C. E. Warren (A'41) of Ohio State University, Columbus, for their paper, "Determination of Transient Shaft Torques in Turbine Generators by Means of the Electrical–Mechanical Analogy," presented at the 1945 winter technical meeting, January 22–26, and published in the 1945 *Transactions*, pages 51–6. Honorable mention was awarded to V. E. Legg (M'37) of Bell Telephone Laboratories, Inc., New York, N. Y., for his paper, "Optimum Air Gap for Various Magnetic Materials in Cores of Coils Subject to Superposed Direct Current," published in the 1945 *Transactions*, pages 709–12.

Best Paper in Public Relations and Education. Prize awarded to Aram Boyajian (F'26) of the General Electric Company, Pittsfield, Mass., for his paper, "Cultural Training of the Engineer," presented at the 1944 winter technical meeting, January 24–28, and published in 1944 *Transactions*, pages 6–9.

Initial Paper. Prize awarded to G. W. Scott, Jr. (M'45) of the Armstrong Cork Company, Lancaster, Pa., for his paper, "The Role of Frequency in Industrial Dielectric Heating," published in the 1945 *Transactions*, pages 558–62. Honorable mention was awarded to H. M. Elsey (M'44) of the Westinghouse Electric Corporation, East Pittsburgh, Pa., for his paper, "Treatment of High-Altitude Brushes by Application of Metallic Halides," published in the 1945 *Transactions*, pages 576–9.

DISTRICT PRIZES

District prizes for AIEE papers have been announced by five Districts. The awards are for papers presented during 1945. Each District prize consists of an appropriately engrossed certificate and check for $25, divided in cases of coauthors.

District 2

Prize for best paper was awarded to E. W. Boehne (F'43) and W. A. Atwood for their paper, "Anode-Circuit-Breaker Design and Performance Criteria," presented at a meeting of the Philadelphia Section, February 12, 1945.

Prize for initial paper was awarded to William B. Keller (A'41) for his paper, "Aircraft Regulators and Relays," presented at a meeting of the Cleveland Section, December 4, 1945.

District 7

Prize for Branch paper was awarded to Duane G. Harman for his paper, "Hyper- and Ultrahigh-Frequency Effects on Vacuum Tubes," presented at a meeting held at Southern Methodist University, January 31 and February 1, 1945.

District 8

Prize for best paper was awarded to J. V. Kresser (M'43) for his paper, "Characteristics and Limitations of Transformer Connections," presented at a meeting of the San Francisco Section, November 16, 1945.

Prize for initial paper was awarded to C. J. Breitwieser (M'44) for his paper, "Constant-Speed Drives for Aircraft Alternators," published in the 1945 Transactions, pages 763-8.

District 9

Prize for best paper was awarded to E. C. Goodale (M'45) and J. I. Holbeck (M'36) for their paper, "Field Determination of Current Transformer Errors by the Secondary-Voltage Method," presented at a meeting of the Portland Section, April 3, 1945.

District 10

Prize for best paper was awarded to W. B. Buchanan (M'32) and G. D. Floyd (M'28) for their paper, "Field Tests of Interrupting Capacity of 138-Kv Oil Circuit Breakers," presented at a meeting of the Toronto Section, October 12, 1945.

Trial Period Extended on Members-for-Life Awards

A four-year instead of a two-year trial period for the awards of trips to the summer convention to winners of the District prizes for Branch papers has been decided upon. The decision of the committee on members-for-life fund was made in view of the disturbed conditions which have prevailed in the universities and colleges during the past few years.

The awards which were announced in the January 1945 issue of *Electrical Engineering*, page 31, provide for the payment of expenses of five winners of District prizes for Branch papers to the summer convention for the purpose of presenting their papers. The even-numbered Districts would be eligible one year, and the odd-numbered ones the next. Experience gained in the next four years will determine whether or not the utilization of the members-for-life fund for this purpose will be continued permanently.

Board of Directors Meeting Held in Asheville

The regular meeting of the AIEE board of directors was held at Grove Park Inn, Asheville, N. C., May 14–15, 1946, during the Southern District meeting of the Institute.

The board confirmed its previous action by letter ballot authorizing a contribution of $15,000 toward a survey by the United Engineering Trustees, Inc., of the situation with respect to the increasing inadequacy of the engineering societies headquarters building for the Founder Societies and the need for its renovation or for a new building. The AIEE board has gone on record as recommending that UET explore the possibility of creating or obtaining adequate headquarters for all national engineering societies and kindred organizations which may wish to participate.

The Institute's annual appropriation for the American Co-ordinating Committee on Corrosion was increased from $25 to $50, and the annual payment to the United States National Committee of the International Commission on Illumination was increased to $150.

Sections committee recommendations for an increase in the financial allotments to those Sections having definitely increased activities, for which the present appropriations are inadequate, were confirmed as the basis for Sections' appropriations during the coming year. These recommendations were for the retention of the basic yearly allotments of $200 to each Section and $1.20 for each Institute member within the Section on August 1, and for an increase in the allotments for additional regularly scheduled meetings of the Section, Subsections, and technical groups in the Section during the preceding fiscal year as indicated below:

Number of Meetings	Proposed Allotment	Present Allotment
12 to 17	$ 50	$25
18 to 23	100	50
24 to 29	150	75
30 or more	200	75

Also recommended was a basic yearly allotment of $100 to a Section for the operation of each Subsection holding regularly scheduled meetings.

An extensive discussion of Institute activities resulted in actions concerning technical committees, Institute publications, and headquarters staff functions reported in the June issue (pages 269–70). The subject of visits of the president with Sections was given comprehensive consideration, as the Institute has grown so large that changes in the policy regarding such visits are essential. The committee on planning and co-ordination was requested to study the subject and make recommendations. By vote, the board strongly commended the committee on planning and co-ordination and its subcommittees on technical activities and professional activities, and emphatically recommended continuance of their work next year.

Upon request of the District officers, payment in September of the present appropriation year of travel expenses in connection with the North West District executive committee meeting for 1946–47, which is to be held during the Pacific Coast convention in August (in advance of the 1946–47 appropriation year), was authorized.

A meeting of the North Eastern District was authorized to be held in Worcester, Mass., April 23–25, 1947.

The chairman of the 1946 winter convention committee, who has been making some tentative arrangements for the 1947 convention, having requested a definite statement of the board's policy regarding exhibits of electric equipment which might be held concurrently with the convention,

the board voted to authorize the use by an exhibit company of the phrase "to be held concurrently with the AIEE winter convention."

The board referred to the technical program committee an inquiry as to whether the Institute could supply some technical papers for the National Electronics Conference, to be held in Chicago, Ill., October 3–5, 1946, and approved a proposal of that committee that the chairman of the committee on electronics appoint a subcommittee of three AIEE members in the Chicago Section to arrange for AIEE participation in the conference.

Upon recommendation of the Standards committee, the board took the following actions: Approved the appointment of R. C. Putnam (M '34) as AIEE representative, and Professor E. M. Strong (M '40) as alternate, on ASA Sectional Committee A23, which will undertake a revision of the "American Recommended Practice for School Lighting" (in place of former representative G. H. Stickney (F '24) who has retired); approved the appointment of Professors C. L. Dawes (F '35) and D. T. Canfield (M '31) as AIEE representatives on Sectional Committee C12, which will undertake a revision of the "Code for Electricity Meters" (to replace the two former representatives, who have resigned).

As the result of the board's approval in October 1945 of a recommendation that the definition of a "university or technical school of recognized standing" be made consistent with the present practice of accrediting engineering schools by The Engineers Council for Professional Development, section 51 of the bylaws was amended to read as follows:

Sec. 51. Any person registered as a student, graduate, or undergraduate, in a university or technical school of recognized standing may be enrolled as a Student member of the American Institute of Electrical Engineers, except that a graduate student whose term of enrollment, as specified in Section 53, has expired may not again enroll. The expression "university or technical school of recognized standing" is interpreted as applying to any school of college grade which provides an engineering curriculum which prepares students for the profession of electrical engineering and which is fully accredited by Engineers' Council for Professional Development. If the curriculum is not fully accredited by Engineers' Council for Professional Development, the Board may waive this requirement on the recommendation of the committee on Student Branches.

In accordance with section 37 of the constitution, the appointment of a secretary of the Institute for the administrative year commencing August 1, 1946, was considered, and Secretary H. H. Henline was reappointed with an expression of appreciation of his efficient services.

Vice-President M. S. Coover (F '42) was appointed a representative of the Institute on the Washington Award Commission for the two-year term commencing June 1, 1946, succeeding L. R. Mapes (F '37) whose term expired at that time.

Upon recommendation of the executive committees of the Districts concerned and the chairman of the Sections committee and upon request of the San Francisco Section, the Territory of Hawaii was transferred from the New York City District (3) to the Pacific District (8), and added to the territory of the San Francisco Section.

Report was made of the continued cooperation of the committee on air transportation with the Society of Automotive Engineers and the National Aircraft Standards Committee in aeronautical electrical standardization work.

Appointment by the president of the following committee of tellers, to canvass, count, and report on the ballots for the election of AIEE officers, was approved:

Charles H. Wagner (F '40) *chairman;* D. F. Hall (A '43); E. W. Hilbert (M '46); K. K. Lacher (A '45); R. R. MacGregor (A '42); Charles S. Murray, Jr. (A '34); and Earl G. Ports (M '34).

General funds disbursements for April, a total of $40,205.53, were reported by Chairman W. R. Smith of the finance committee and approved.

A resolution was adopted directing the removal from the active membership list of the names of the members in arrears for dues of the fiscal year which commenced May 1, 1945, and extending the time for the payment of such dues until further action by the board of directors.

Present at the meeting were:

President—W. E. Wickenden, Cleveland, Ohio. *Past President*—C. A. Powel, East Pittsburgh, Pa. *Vice-Presidents*—C. B. Carpenter, Portland, Oreg.; F. F. Evenson, San Diego, Calif.; J. F. Fairman, New York, N. Y.; E. S. Fields, Cincinnati, Ohio; R. T. Henry, Buffalo, N. Y.; F. L. Lawton, Montreal, Canada; Herman B. Wolf, Charlotte, N. C. *Directors*—P. L. Alger, Schenectady, N. Y.; J. M. Flanigen, Atlanta, Ga.; C. W. Mier, Dallas, Tex.; S. H. Mortensen, Milwaukee, Wis.; W. B. Morton, Allentown, Pa; J. R. North, Jackson, Mich.; D. A. Quarles, New York, N. Y.; Walter C. Smith, San Francisco, Calif.; W. R. Smith, Newark, N. J. *Secretary*—H. H. Henline, New York, N. Y. By invitation: J. Elmer Housley, *presidential nominee;* E. W. O'Brien, *chairman,* committee on Student Branches; M. D. Hooven, *chairman,* technical activities subcommittee of the committee on planning and co-ordination.

Annual Additions to List of Members for Life

Membership for life is granted by the AIEE to members who either have paid annual dues for 35 years, or have reached the age of 70 and paid dues for 30 years. A list of those who have become members for life during the preceding year is published annually in *Electrical Engineering.* Institute members who have attained this status since publication of the last list in the July 1945 issue are:

R. V. Achatz
A. J. Althouse
G. M. Armbrust
J. B. Arthur
A. Bachrach
S. A. K. Barrett
W. R. Battey
A. E. Bauhan
H. Baum
W. E. Beaty
R. Beman
C. E. Bennett
N. C. Benson
E. L. Bettanier
B. K. Boyce
F. F. Brand
H. P. Broderson
R. A. Brown
R. P. Brown
H. H. Buell
W. H. R. Burrows
H. A. Burt
E. R. Candor
R. F. Carbutt
W. N. Chaffee
P. I. Chandeysson
C. E. Connard
H. A. Cowgill
J. S. Cruikshank
A. C. Cummins
R. E. Cunningham
L. M. Dawes
E. E. de Souza
F. E. d'Humy
G. H. Dorgeloh
H. G. Dorsey
C. W. Drake
J. V. B. Duer
C. H. Eames
R. N. Early
C. T. Evans
F. R. Ewart
W. S. Ewens
D. D. Ewing
R. H. Fenkhausen
G. Fiske
C. E. Fleager
S. G. Forbes
B. P. Foster
R. A. Fulton
P. M. Fee
L. S. Goodman
M. C. Goodspeed
H. Goodwin, Jr.
H. P. Gorman
S. B. Graham
A. H. Grimsley
F. M. Gunby
C. I. Hall
M. S. Hall
H. B. Hammond
R. H. Harvey
L. F. Harza
G. C. Hecker
H. H. Henningson
G. Hirsch
L. W. Hitchcock
J. V. L. Hogan
R. B. Howland
A. P. Hyatt
G. C. Hyde
A. W. Janowitz
C. A. Jaqua
F. Jeffrey
C. G. Johnson
B. W. Jones
J. A. Jones
R. L. Jones
L. C. Josephs, Jr.
G. A. Kelsall
W. P. Kennedy
L. M. Klauber
G. L. Knight
J. A. Koontz, Jr.
G. E. Lewis
F. M. Loud
O. MacMurray
F. W. MacNeill
E. H. Martindale
A. L. Matte
E. L. Moreland
J. J. Mullen
J. F. Murray
E. R. Nigh
A. A. Nims
H. R. Noack
R. Norsa
E. L. Nute
H. S. Osborne
R. Page
G. K. Paton
L. T. Peck
G. G. Post
O. G. Pratt
R. L. Quass
K. Richards
H. K. Ritter
C. A. Robinson
M. H. Roffey
G. H. Schaeffer
H. J. Schiefer, Jr.
E. G. Schmeisser
A. P. C. Schramm
G. Smith
J. U. Smith
G. T. Southgate
G. E. Stack
R. T. Stafford
E. H. Steele
A. B. Stewart
E. N. Strait
L. V. Sutton
F. Swanstrom
C. F. Terrell
L. A. Terven
P. Thomas
A. C. Towers
J. O. Tucker
J. S. van Bylevelt
S. G. Vinson
C. P. Walker
C. A. M. Weber
A. F. Welch
F. M. Weller
R. B. Wendell
R. L. Witham

Section and Branch Activities—Annual Report for 1945-46

The following constitutes the annual report on Institute Section and Branch activities for the fiscal year which ended April 30, 1946. Similar information for three preceding fiscal years appeared in *Electrical Engineering* in June 1945, pages 228–9; June 1944, pages 224–5; and June 1943, pages 264–5.

Present members of the Sections committee and the committee on Student Branches, supervising the divisions of Institute activities covered by this report, which appears on the following pages are:

Sections—G. W. Bower, *chairman;* R. M. Pfalzgraff, *vice-chairman;* A. C. Muir, *secretary;* O. C. Brill; M. S. Coover; W. E. Enns; C. W. Evans; F. F. Evenson; H. P. Heafer; V. P. Hessler; W. R. Hough; Frederick Krug; F. L. Lawton; T. M. Linville; E. T. Mahood; R. G. Porter; C. S. Purnell; and, ex officio, chairmen of all Institute Sections.

Branches—E. W. O'Brien, *chairman;* M. M. Cory; H. L. Davis, Jr.; A. G. Ennis; T. G. LeClair; Everett S. Lee; Walter Charles Smith; E. M. Strong; R. G. Warner; C. R. Wischmeyer; and, ex officio, all Student Branch counselors.

Table I. Section Membership and Meetings During Year Ending April 30, 1946

Section	AIEE Members August 1944	AIEE Members August 1945	Number of Meetings	Average Attendance
Akron	104..	105....	8...	69
Electronic technical discussion group			2...	70
Alabama	44..	37....	8...	41
Arizona	50..	60....	9...	47
Beaumont		61....	11...	59
Boston	604..	673....	10...	261
Electronics group			3...	150
Industrial power application group			3...	87
Instruments and measurements group			4...	90
Insulation group			2...	82
Transmission and distribution group			4...	74
Central Indiana	148..	147....	10...	79
Chicago	869..	961....	3...	172
Communications group			4...	145
Electronics group			4...	179
Industrial group			4...	72
Power group			4...	118
Cincinnati	149..	161....	11...	256
Electronics discussion group			4...	50
General industrial applications discussion group			2...	51
Technical discussion group			2...	56
Cleveland	390..	424....	16...	280
Electronics group			8...	29
Illumination group			1...	6
Motors and control technical group			2...	53
Columbus	84..	90....	8...	93
Zanesville Subsection			12...	22
Connecticut	363..	384....	6...	84
Dayton	173..	243....	10...	151
Aeronautical technical discussion group			6...	51
Industrial electronics technical discussion group			5...	31
Motors and control technical discussion group			5...	60
Denver	192..	209....	9...	88
East Tennessee	206..	288....	17...	83
Technical group meetings			9...	17
Erie	74..	73....	10...	52
Florida	134..	125....	2...	55
Florida West Coast Subsection			1...	30
Miami Subsection			1...	39
Fort Wayne	107..	107....	10...	41
Georgia	115..	145....	12...	97
Houston	180..	143....	11...	67
Communications technical group			4...	28
Industrial applications technical group			4...	30
Illinois Valley		47..	15...	92
Electronics – radio technical group			4...	40
Industrial maintenance technical group			1...	105
Power distribution technical group			2...	18
Production and transmission technical group			1...	8
Iowa	78..	85....	4...	24
Ithaca	65..	72....	10...	105
Dielectric heating discussion group			6...	33
Kansas City	146..	149....	13...	110
Electronics group			4...	9
Industrial practice technical group			16...	8
Lehigh Valley	179..	188....	9...	67
Los Angeles	635..	723....	9...	208
Boulder Dam Subsection			3...	30
Aircraft division			7...	77
Electronics division			5...	153
Power division			3...	197
Louisville	75..	75....	8...	54
Lynn	211..	210		
Madison	75..	81....	7...	35
Rock River Valley Subsection			8...	62
Mansfield	65..	63....	8...	121
Maryland	381..	417....	10...	185
Lancaster – York Subsection			7...	100
Memphis	72..	94....	10...	36
Little Rock Subsection			6...	34
Mexico	83..	181		
Michigan	404..	435....	7...	155
Saginaw Valley Subsection			6...	99
Electronics group			4...	64
Industrial power group			1...	269
Round table meetings			5...	81
Milwaukee	371..	409....	11...	254
Basic sciences group			4...	50
Electric machinery group			4...	36
Electronics group			6...	50
Power applications and control group			4...	60
Transmission and distribution group			3...	32
Minnesota	124..	133....	11...	98
Arrowhead Subsection			8...	71
Montana	36..	71....	7...	36
Great Falls Subsection			8...	27
Montreal	208..	237....	14...	130
Ottawa Subsection			11...	47
Muscle Shoals	22..	19....	8...	23
Nebraska	51..	48....	6...	38
New Mexico – West Texas	54..	57....	13...	47
Albuquerque Subsection			5...	17
Technical group meetings			6...	15
New Orleans	151..	159....	10...	74
Lake Charles Subsection			9...	27
Shreveport Subsection			2...	26
New York	3,814..	3,949....	2...	380
Basic science group			6...	148
Communication group			6...	488
Illumination group			4...	277
Power and industrial group			9...	126
Transportation group			3...	37
New Jersey activities committee			4...	184
Niagara Frontier	185..	198....	8...	74
Niagara Falls Subsection			4...	58
North Carolina	119..	137....	1...	
Charlotte Subsection			5...	27
North Texas	177..	199....	10...	81
Panhandle Subsection			9...	39
Oklahoma City	100..	109....	9...	98
A-c circuit analysis group			5...	7
Electronics group			5...	12
Frequency modulation group			4...	6
Joint rural service group			4...	9
Physics and nuclear physics group			3...	4
Transmission and distribution group			4...	12
Philadelphia	892..	925....	10...	195
Wilmington Subsection			10...	95
Electrification of industrial plants discussion group			3...	15
Aircraft electrical engineering discussion group			1...	30
Basic science discussion group			2...	153
Communication discussion group			4...	198
Electronics discussion group			3...	37
Industrial practice discussion group			3...	43
Instruments and measurements discussion group			3...	90
Power systems discussion group			3...	46
Pittsburgh	663..	693....	12...	177
Pittsfield	196..	200....	8...	109
Popular lectures			6...	1,100
Electronics technical group			5...	23
Portland	189..	228....	16...	117
Communications group			1...	130
Electrochemical and electrometallurgical group			1...	38
Industrial electronic group			4...	112
Marine technical group			1...	34
Transmission and distribution group			1...	100
Providence	101..	105....	8...	167
Rochester	124..	133....	8...	171
Luncheon meetings			4...	43
Communications group			1...	108
Power discussion group			1...	30
St. Louis	320..	347....	11...	111
Electronics discussion group			5...	14
Industrial power practices discussion group			5...	17
San Diego	74..	102....	12...	66
San Francisco	682..	771....	13...	221
Fresno Subsection			5...	74
Sacramento Subsection			8...	75
Electronics group			7...	58
Industrial practices group			5...	47
Power group			4...	54
Schenectady	619..	654....	5...	396
Technical discussion meetings			4...	185
Aviation group			6...	85
Industrial electronics group			4...	59
Industrial power applications group			4...	38
Seattle	274..	304....	13...	149
Aircraft technical group			1...	138
Electronics technical group			2...	95

Table I. Section Membership and Meetings During Year Ending April 30, 1946 (Continued)

Sections	AIEE Members August 1944	AIEE Members August 1945	Number of Meetings	Average Attendance
Power technical group			4	53
Sharon	135	149	9	106
South Bend	60	70	10	46
Industrial power problems technical group			2	13
South Carolina	47	56	2	68
Charleston Subsection			2	15
South Texas	48	56	7	46
Spokane	103	106	9	45
Springfield	55	60	9	107
Electronics group			6	23
Syracuse	126	149	7	125
Toledo	87	67	10	52
Toronto	381	400	16	206
Hamilton Subsection			8	78
Niagara District Subsection			1	50
Communications technical group			3	54
Discussion group			9	42
Tulsa	73	81	8	67
Technical meetings			9	8
Urbana	87	38	4	50
Utah	79	77	15	59
Vancouver	101	109	11	120
Virginia	147	138	4	174
Hampton Roads Subsection			4	55
Richmond Subsection			2	34
Washington	707	724	10	294
Technical group meetings			8	94
West Virginia	39	50	10	133
Wichita	74	86	12	68
Worcester	65	59	8	65
	18,415	19,918	1,187	

Total Sections, 75 — Total technical groups, 85
Total Subsections, 25 — Total Attendance, 116,294

Table II. Section Meetings Held During Last Three Fiscal Years

	Fiscal Year Ending April 30		
	1944	1945	1946
Number of Sections	73	73	75
Number of meetings held	738	884	1,187
Average number of meetings	10.1	12.1	15.8
Total attendance	83,120	96,346	116,294
Average attendance per meeting	113	109	98

Table III. Branch Meetings Held During Last Three Fiscal Years

	Fiscal Year Ending April 30		
	1944	1945	1946
Number of Branches	125	125	125
Number of meetings held	755	542	718
Average number of meetings	6.0	4.3	5.8
Total attendance	24,768	17,137	23,473
Average attendance per meeting	33	32	33

Table IV. Branch Meetings Held During Year Ending April 30, 1946

Branch	Number	Average Attendance
Akron, University of	4	33
Alabama Polytechnic Institute	0	0
Alabama, University of	0	0
Alberta, University of	6	29
Arizona, University of	0	0
Arkansas, University of	6	12
British Columbia, University of	18	35
Brooklyn, Polytechnic Institute of		
Day division	8	44
Evening division	2	19
Brown University	2	39
Bucknell University	1	23
California Institute of Technology	8	38
California, University of	8	34
Carnegie Institute of Technology	51	28
Case School of Applied Science	7	54
Catholic University of America	3	10
Cincinnati, University of	0	0
Clarkson College of Technology	2	15
Clemson Agricultural College	10	17
Colorado State College	0	0
Colorado, University of	13	77
Columbia University	13	32
Connecticut, University of	0	0
Cooper Union		
Day division	3	15
Evening division	0	0
Cornell University	11	59
Delaware, University of	1	15
Denver, University of	5	25
Detroit, University of	6	30
Drexel Institute of Technology	5	37
Duke University	16	40
Florida, University of	1	55
George Washington University	5	44
Georgia School of Technology	0	0
Harvard University	1	26
Idaho, University of	8	24
Illinois Institute of Technology	10	52
Illinois, University of	3	29
Iowa State College	2	9
Iowa, University of	12	14
Johns Hopkins University	8	14
Kansas State College	10	68
Kansas, University of	2	30
Kentucky, University of	11	36
Lafayette College	2	15
Lehigh University	1	28
Louisiana State University	8	17
Louisville, University of	8	49
Maine, University of	0	0
Manhattan College	5	30
Marquette University	9	27
Maryland, University of	5	23
Massachusetts Institute of Technology	6	136
Michigan College of Mining and Technology	8	0
Michigan State College	1	20
Michigan, University of	12	57
Milwaukee School of Engineering	2	187
Minnesota, University of	0	0
Mississippi State College	6	16
Missouri School of Mines and Metallurgy	0	0
Missouri, University of	6	21
Montana State College	8	18
Nebraska, University of	9	18
Nevada, University of	0	0
Newark College of Engineering	2	23
New Hampshire, University of	0	0
New Mexico State College	3	12
New Mexico, University of	1	39
New York, College of the City of		
Day division	18	47
Evening division	0	0
New York University		
Day division	0	0
Evening division	7	40
North Carolina State College	5	28
North Dakota Agricultural College	2	10
North Dakota, University of	0	0
Northeastern University	8	31
Northwestern University	7	40
Norwich University	0	0
Notre Dame, University of	3	36
Ohio Northern University	1	9
Ohio State University	6	11
Ohio University	0	0
Oklahoma Agricultural and Mechanical College	2	34
Oklahoma, University of	6	40
Oregon State College	8	33
Pennsylvania State College	3	43
Pennsylvania, University of	3	41
Pittsburgh, University of	15	96
Pratt Institute	0	0
Puerto Rico, University of	5	28
Princeton University	4	14
Purdue University	11	0
Rensselaer Polytechnic Institute	2	14
Rhode Island State College	0	0
Rice Institute	9	31
Rose Polytechnic Institute	2	16
Rutgers University	1	15
Santa Clara, University of	0	0
South Carolina, University of	5	24
South Dakota State College	7	34
South Dakota State School of Mines	4	14
Southern California, University of	18	22
Southern Methodist University	0	0
Stanford University	2	35
Stevens Institute of Technology	0	0
Swarthmore College	0	0
Syracuse University	1	5
Tennessee, University of	7	19
Texas Agricultural and Mechanical College	6	32
Texas Technological College	10	20
Texas, University of	12	55
Tufts College	4	32
Tulane University	10	27
Union College	7	33
Utah, University of	5	28
Vanderbilt University	4	12
Vermont, University of	1	46
Villanova College	10	33
Virginia Military Institute	1	25
Virginia Polytechnic Institute	12	51
Virginia, University of	19	33
Washington, State College of	11	32
Washington, University of	6	79
Washington University	8	21
West Virginia University	7	9
Wisconsin, University of	11	26
Worcester Polytechnic Institute	2	25
Wyoming, University of	11	19
Yale University	5	57
	718	

Total, 125 Branches

Joint Inspection Trip Ends Season for Pittsburgh Section

A joint meeting with the electrical section of the Engineers' Society of Western Pennsylvania held at the Springdale station of the West Penn Power Company, May 14, drew an attendance of more than 250 to the last technical meeting of the 1945–46 season of the Pittsburgh Section.

Inspection of the company's number 7 addition was the chief attraction of the trip to the station 20 miles from Pittsburgh. Representatives of many suppliers of major equipment installed in the station also were present.

The group was welcomed by E. F. Randolph, superintendent of the Springdale station. Electrical features of the new addition were discussed by H. A. P. Langstaff (F '43) electrical engineer of the company, and mechanical details were explained by J. T. Rummell.

Communications and Electronics Group Formed in Georgia

An address on "Recent Developments in Electronics" by Doctor R. I. Sarbacher (M '41) dean of the graduate studies division, Georgia School of Technology, Atlanta, was featured at the first meeting of the technical group on communications and electronics of the AIEE Georgia Section. Approximately 75 members and guests attended the evening meeting.

Officers of the newly organized technical group, which has 39 charter members, are:

Chairman—R. I. Sarbacher.

Vice-chairman—Newton B. Fowler, division plant supervisor, American Telephone and Telegraph Company, Atlanta.

Secretary-treasurer—Robert P. Posey, consulting application engineer, Westinghouse Electric Corporation, Atlanta.

Prize Paper Meeting Held at Sharon

The May meeting of the Sharon Section was devoted to the presentation of four prize papers and two which had received honorable mention in a contest which originated last fall. A prize paper committee was set up at that time to encourage the submission of technical papers, and the May meeting was the culmination of its program.

A total of 11 papers was received and passed on by a board of three judges. Two presentation prizes also were awarded, and all six winners were equally eligible for these. The four paper prizes were $37.50, $25, $15, and $7.50. The presentation prizes were $10 and $5.

The meeting was one of the best attended of the year and the program is being considered as an annual event.

PERSONAL ....

James DeKiep (M '43) chief engineer, Electric Machinery Manufacturing Company, Minneapolis, Minn., has been awarded the 1945 national best paper prize in the field of engineering practice as coauthor of the paper, "The Application of Silicone Resins to Insulation for Electric Machinery." Born in Grand Haven, Mich., in 1905, Mr. DeKiep was graduated from the University of Michigan in 1927 with the degree of bachelor of science in electrical engineering. He joined the Westinghouse Electric Corporation, East Pittsburgh, Pa., in 1929, working on the design and application of a-c motors and generators until 1942, at which time he was made section engineer in charge of the a-c section of the motor engineering department. He entered the employ of the Electric Machinery company in 1945.

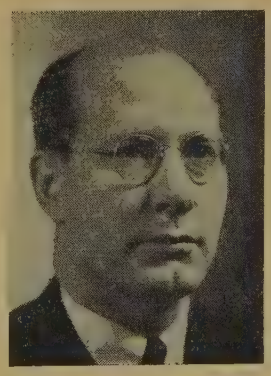
G. L. Moses (A '43, M '44) section engineer, development insulation, transportation and generator division, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been awarded the 1945 national best paper prize in the field of engineering practice as coauthor of the paper, "The Application of Silicone Resins to Insulation for Electric Machinery." Mr. Moses was born in Knoxville, Tenn., in 1904, and attended Bliss Electrical School. He entered the employ of the Westinghouse company as a member of the student training course in 1923. He has been sales correspondent, railway control engineer, and coil and insulation engineer. Since 1942 he has been engineer in charge of the insulation development group.

C. E. Warren (A '41) assistant professor of electrical engineering, Ohio State University, Columbus, has received the 1945 national best paper prize in the field of theory and research as coauthor of the paper, "Determination of Transient Shaft Torques in Turbine Generators by Means of the Electrical–Mechanical Analogy." Professor Warren was born in 1914 in Columbus, Ohio, and received the degree of bachelor of electrical engineering from Ohio State University in 1938 and the degree of master of science from Massachusetts Institute of Technology in 1940. He was assistant in electrical engineering at Massachusetts Institute of Technology, Cambridge, from 1938 to 1940 and in 1940 entered the employ of the Westinghouse Electric Corporation, East Pittsburgh, Pa., as industry engineer. He joined the staff of Ohio State University in 1944.

G. D. McCann (A '38, M '44) consulting transmission engineer, industry engineering department, Westinghouse Electric Corporation, East Pittsburgh, Pa., has been awarded the national best paper prize for 1945 in the field of theory and research as coauthor of the paper, "Determination of Transient Shaft Torques in Turbine Generators by Means of the Electrical–Mechanical Analogy." Doctor McCann was born in Glendale, Calif., in 1912, and holds the degrees of bachelor of science (1934) master of science (1935), and doctor of philosophy (1939) from California Institute of Technology. He was teaching fellow at the California Institute of Technology, Pasadena, from 1935 to 1938 and in 1938 joined the Westinghouse corporation as transmission engineer. He is the author of numerous papers and a member of Sigma Xi.

Aram Boyajian (A '18, F '26) electrical engineer, General Electric Company, Pittsfield, Mass., has been awarded the national best paper prize for 1945 in the field of public relations and education for his paper, "Cultural Training of the Engineer." Mr. Boyajian was born in Armenia in 1888, and received the bachelor of arts degree from Anatolia College, and his bachlor of science degree in 1915 and his electrical engineering degree in 1918 from Swarthmore College. He has been engaged in consulting engineering for the General Electric Company since 1917. He has published a number of papers and articles.

G. W. Scott, Jr. (M '45) assistant chief physicist, Armstrong Cork Company, Lancaster, Pa., has been awarded the 1945



James De Kiep

C. E. Warren

G. L. Moses

national prize for initial paper for his paper, "The Role of Frequency in Industrial Dielectric Heating." Doctor Scott, who was born in 1912 in Auburn, N. Y., received the degree of bachelor of arts from Wesleyan University in 1934 and the degrees of master of arts in 1935 and doctor of philosophy in 1938 from Cornell University. From 1938 to 1940 he had a post doctorate fellowship in applied electronics at Massachusetts Institute of Technology, Cambridge. In 1940 he became a research associate at the institute. He joined the Armstrong company in 1941. He was a teaching and research assistant at Cornell University, Ithaca, N. Y., from 1934 to 1938. Doctor Scott has published a number of papers and is a member of the American Physical Society, the American Welding Society, and Sigma Xi.

Aram Boyajian

G. D. McCann

G. W. Scott, Jr.

L. J. Gorman (A '11, M '30) assistant engineer, electrical engineering department, Consolidated Edison Company of New York (N. Y.), Inc., has received honorable mention in the field of engineering practice in the 1945 national prize paper awards for his paper, "Electrolysis and Corrosion of Underground Power System Cables." Born in Waddington, N. Y., in 1887, Mr. Gorman received his bachelor of science degree from Clarkson College of Technology in 1909. After graduation he spent one year each with the General Electric Company, Schenectady, N. Y., and one with Stevens Institute of Technology, Hoboken, N. J. In 1911 he entered the employ of New York Edison Company and, except during World War I when he served overseas as a captain in the Signal Corps, has been with the Edison system ever since. He has been tester, foreman, general foreman, electrolysis engineer, and assistant engineer.

V. E. Legg (M '37) engineer in the apparatus development department, Bell Telephone Laboratories, Inc., New York, N. Y., has received honorable mention in the field of theory and research for his paper, "Optimum Air Gap for Various Magnetic Materials in Cores of Coils Subject to Superposed Direct Current," in the 1945 national prize paper awards. Born in Ann Arbor, Mich., in 1897, Mr. Legg holds the degrees of bachelor of science (1920) and master of science (1922) from the University of Michigan. He was research physicist with the Detroit Edison Company in 1920 and 1921 and in 1923 entered the research department of the Western Electric Company, which in 1925 became the Bell Telephone Laboratories. He since has been engaged in cable research and has more than 20 patents, both American and British, to his credit. From 1929 to 1931 he was in Germany supervising the manufacture and application of continuous loading to experimental telephone cable. He is a member of the American Society for Metals, the American Physical Society, and the American Association for the Advancement of Science.

H. M. Elsey (M '44) consulting chemist, Westinghouse Research Laboratories, Westinghouse Electric Corporation, East Pittsburgh, Pa., has received honorable mention for initial paper in the 1945 national prize paper awards for his paper, "Treatment of High-Altitude Brushes by Application of Metallic Halides." Born in 1891 in Seattle, Wash., Mr. Elsey received the degrees of bachelor of arts in 1914, master of arts in 1915, and doctor of philosophy in 1919 from Stanford University. He joined the faculty of the University of Kansas, however, in 1918 as assistant professor of chemistry and was appointed associate professor in 1921. Since 1925 he has been consulting chemist for the Westinghouse corporation. He is a member of the American Chemical Society, the American Association for the Advancement of Science, the Chemical Society (London, England), and the Society of Chemical Industry.

Ralph Bown (M '30, F '41) formerly assistant director of research, Bell Telephone Laboratories, Inc., New York, N. Y., has been named director of research. He succeeds **M. J. Kelly** (M '26, F '31) who has been serving as both director of research and executive vice-president and who will continue in the latter position. Doctor Bown received the degree of mechanical engineer from Cornell University in 1913, the master's degree in 1915 and his doctor's degree in 1917. During World War I he was officer in charge of radio development work at the United States Army Signal Corps Radio Laboratories at Camp Alfred Vail, N. J. Afterwards he joined the department of development and research of the American Telephone and Telegraph Company. In 1934 he was appointed associate director of radio research for the laboratories, and in 1937 director of radio and television research. He became assistant director of research in 1944. He served as division member and consultant to the National Defense Research Council and was sent to England to study radar in 1941. He also was a War Department consultant. Doctor Bown was president of the Institute of Radio Engineers in 1927 and in that year received the Morris Liebmann prize in recognition of his research into wave transmission phenomena.

H. P. Sleeper (A '22, M '30) operating engineer, electric distribution department, Public Service Electric and Gas Company, Newark, N. J., has been presented with the company's Thomas N. McCarter Electric Award for 1945 "in recognition of his leadership and direction in the development of relay protection for the transmission and distribution system which has resulted in notably improved service reliability and substantial savings in system investment." The award is given annually to the employee in either the operating or commercial group of the electric department who contributed most during the year toward the efficiency and progress of the department. Mr. Sleeper, a graduate of the University of Maine, joined the Public Service Company in 1925 and has been operating engineer since 1940. He has been chairman of the AIEE committee on protective devices. Mr. Sleeper, a veteran of World War I, has been active in the moral rearmament movement and in 1945 participated in the training center activities at Mackinac Island, Mich., which were attended by leaders in government and industry from the United States, Canada, and other countries.

T. G. LeClair (A '24, F '40) chief staff engineer, Commonwealth Edison Company, Chicago, Ill., has been elected president of the Western Society of Engineers for the year 1946–47. With the Edison company since 1923, Mr. LeClair has held the positions of cable engineer, assistant field engineer, engineer of system protection, development engineer, and staff engineer. Mr. LeClair, at present an AIEE vice-president, has served on many AIEE committees. He is currently chairman of the professional activities subcommittee of the committee on planning and co-ordination. He is a director and past president of the Illinois Engineering Council and a member of the Illinois Society of Engineers and the National Society of Professional Engineers. A fuller biography of Mr. LeClair may be found in the March 1946 issue of *Electrical Engineering*, page 132.

Walther Richter (M '37, F '42) electrical engineer, engineering development department, Allis-Chalmers Manufacturing Company, West Allis, Wis., has been elected chairman of the AIEE Milwaukee Section for the 1946–47 season.

F. J. Van Zeeland (A '37, M '44) dean and professor of electrical engineering, Milwaukee (Wis.) Engineering School, has been elected secretary–treasurer of the AIEE Milwaukee Section for 1946–47.

W. G. H. Finch (A '22, M '26) president, Finch Telecommunications, Inc., Passaic, N. J., and captain in the United States Naval Reserve, recently was awarded the Legion of Merit "for exceptionally meritorious conduct in the performance of outstanding service to the Government of the United States as head of the Countermeasures Design Section, Electronics Division, Bureau of Ships, from December 1, 1941 to September 1, 1945."

N. L. Freeman (M '45) design engineer, American Locomotive Company, Schenectady, N. Y., has been appointed a member of the New York State Board of Examiners for Professional Engineers and Land Surveyors. Mr. Freeman holds the degrees of bachelor of science in electrical engineering and master of science in physics from Washington University.

I. E. McDougal (A '40) formerly lieutenant, United States Naval Reserve, attached to the Army–Navy Munitions Board, Washington, D. C., has been appointed apparatus sales manager for the Electric Supplies Distributing Company, San Diego, Calif. Mr. McDougal also served aboard an aircraft carrier.

OBITUARY • • • •

Richard Harold Dearborn (A '07, M '14, F '30) dean emeritus of engineering, Oregon State College, Corvallis, died March 21, 1946. Dean Dearborn was born November 2, 1874, in Salem, Oreg., and was graduated from Willamette University with the degree of bachelor of arts in 1895 and from Cornell University with the degree of mechanical engineer in electrical engineering in 1900. After a year with the Portland (Oreg.) General Electric Company, he joined the faculty of the University of Oregon, Eugene, in 1901. The following year he established the department of electrical engineering and continued as head of the department until 1914. He served as electrical engineer on the Oregon State Tax Commission in 1911 and on the Public Service Commission of Oregon from 1913 to 1915. From 1914 to 1933 he was head of the department of electrical engineering at Oregon State College and in 1933 was named dean of engineering. He was director of engineering, science, and management war training for the college from 1940 until his retirement in 1944. He was a member of the Society for the Promotion of Engineering Education, the Northwest Electric Light Power Association, the Corvallis Chamber of Commerce, Tau Beta Pi, Sigma Tau, and Eta Kappa Nu.

Francis Leslie Stevenson (A '03, M '21) retired superintendent of steam and power, International Harvester Company, Chicago, Ill., died February 13, 1946. Mr. Stevenson was born February 7, 1866, in Detroit, Mich., and was graduated from the University of Michigan in 1888. Later he attended the Chicago Law School. He was in the engineering department of the Thomson-Houston Electric Company and the General Electric Company in Lynn and Boston, Mass., in Chicago, and in Pittsburgh, Pa., from 1888 to 1893. He took charge of the electrical department of the Consolidated Street Railway Company, Grand Rapids, Mich., in 1894 and left that position in 1897 to join the Deering Harvester Company which later became the Deering division of the International Harvester Company. After 1905 he was associated with the International Harvester Company as chief electrical engineer, electrical and power engineer, and supervisor of steam and power. Much of his work was concerned with power applications to manufacturing and to steel mill and coal mining operations. He was a member of the American Association for the Advancement of Science and of the Bar of the State of Michigan.

Louis Shapiro (A '36) engineer in the electrical department, Cox and Stevens, New York, N. Y., died April 28, 1946. Mr. Shapiro was born September 10, 1893, in New York, attended Cooper Union, and was graduated from the Hebrew Technical Institute. From 1911 to 1917 he was associated with the New York Edison Company, doing engineering testing for central stations, laboratory work on substations, and statistical work. During World War I he was a second lieutenant in heavy artillery. After the war he spent a year with the Cutler-Hammer Company, and a year with T. E. Murray, Inc., both in New York. He returned to the New York Edison Company in 1921 and remained with that company until 1930 as squad leader, designer, and field supervisor on construction. He was ventilation designer with the New York City Board of Transportation from 1930 to 1932. He rejoined the Edison company in 1936 and became an estimator for Fischbach and Moore, New York, in 1937, and in 1940 electrical designer for the Public Service Electric and Gas Company, Newark, N. J. He had been with Cox and Stevens since 1944.

Edward Byron Elliott (A '17, M '27) engineering department, the Solvay Process Company, Syracuse, N. Y., died March 14, 1946. Mr. Elliott was born January 17, 1886, in Hillsboro, Ohio, and attended Ohio University. He completed an apprenticeship course with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., in 1910 and was attached to the company's Buffalo (N. Y.) district sales office from 1910 to 1912. He joined the Semet-Solvay Company, Syracuse, in 1912 as a member of the staff of the mechanical engineer, was transferred to the staff of the general superintendent in 1918, and was named power engineer in 1922. He was associated with the firm of Stone and Webster, Boston, Mass., from 1924 to 1932, and with the Forstmann Woolen Company, Passaic, N. J., from 1932 to 1934. Since 1934 he had been design engineer with the Solvay Process Company. Mr. Elliott was a member of the Syracuse Technology Club and the Association of Iron and Steel Engineers.

Edgar George Scott (A '10, M '17) consulting engineer, Campbell Soup Company, Moorestown, N. J., died December 25, 1945. Born in Worcester, Mass., in 1882, Mr. Scott was graduated from Worcester Polytechnic Institute in 1905 and received the degree of electrical engineer in 1907. In 1905 he became electrical apprentice for the Westinghouse Electric and Manufacturing Company for one year. He spent two and one half years each with the Boston Elevated Railway and with the consulting firm of N. J. Neall, Boston. He joined the Boott Mills, Lowell, Mass., in 1912 and the Ludlow Manufacturing Association as superintendent of power and repairs in 1913. He was appointed chief engineer of the Campbell Soup Company, Camden, N. J., in 1917 and retired to the position of consulting engineer in 1940. Mr. Scott was a member of the American Society of Mechanical Engineers. He was consulting engineer in the laying out of Strawbridge Park in Moorestown.

Edward L. Adams (A '24) engineer, the Kerite Company, Chicago, Ill., died May 4, 1946. Mr. Adams was born December 1, 1876, in Ashland, Mass., and was graduated from Brown University in 1898 with the degree of mechanical engineer. Mr. Adams commenced his career in the armature department of the General Electric Company, Schenectady, N. Y., and in 1899 entered the electrical engineering department of the Boston (Mass.) Elevated Lines. He was chief signal inspector and assistant signal engineer with the Boston and Albany Railroad from 1902 to 1914. He was senior railway signal engineer with the Interstate Commerce Commission from 1914 until in 1917 he became a captain in the Corps of Engineers and served overseas. After a year with the United States Railroad Administration in 1919, he joined the Kerite Company as sales engineer.

Leon A. Watson (M '35) vice-president in charge of engineering research and development, Clark Controller Company, Cleveland, Ohio, died April 18, 1946. Mr. Watson, who was born August 19, 1887, in Yorktown, N. J., was graduated from Syracuse University in 1910 with the degree of electrical engineer. From 1910 to 1912 he was in the engineering department of the National Electric Lamp Association, Cleveland, and in 1912 joined the Electric Controller and Manufacturing Company, Cleveland, as draftsman and became assistant chief engineer in 1924. In 1925 he helped organize the Clark Controller Company of which he was made chief engineer. For a number of years he was vice-president and chief engineer, and in 1944 he was named vice-president in charge of research and development. He was a member of the AIEE committee on industrial control devices.

Samuel Robert Blair (A '29) assistant chief engineer, Bowater's Newfoundland Pulp and Paper Mills, Corner Brook, died April 17, 1946. Mr. Blair was born October 18, 1893, in Limerick, Ireland. He served as an apprentice for the Limerick Gas and Electric Company from 1910 to 1912. In 1913 he was employed as electrician by the Dominion Bridge Company and the Grand Trunk Railway Company, both of Montreal, Quebec, Canada. He was with the Canadian Pacific Railway Company, Montreal, as electrician from 1914 to 1928. In 1928 he went to Newfoundland as electrical superintendent for the International Power and Paper Company, Corner Brook. He joined the Bowater's mills as electrical superintendent in 1939 and was appointed assistant chief engineer in 1944.

Aubrey Ramon Curry (M '34) electrical engineer, Buffalo (N. Y.), Niagara and Eastern Power Corporation, died February 6, 1946. Born February 12, 1899, in Nassau, Bahamas, B. W. I., Mr. Curry was graduated from London University in 1920 and received the degree of electrical engineer from Cornell University. After completing the graduate student course at the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., in 1921, he became a general tester for the New York (N. Y.) Edison Company. He was junior electrical engineer with the Chile Exploration Company from 1922 to 1924 and in 1924 entered the employ of the Buffalo Niagara company as electrical engineer.

John Harkins (A '21, M '39) district planning engineer, electrical engineering department, Hydro-Electric Power Commission of Ontario, Toronto, Canada, died May 21, 1946. Born in Toronto, September 13, 1896, Mr. Harkins was graduated from the University of Toronto with the degree of bachelor of science in electrical engineering in 1919. Before joining the Hydro-Electric Power Commission in 1921 as electrical draftsman, he was electrical engineer with the Dunlop Tire Company, Toronto. He was made assistant engineer in 1925 and system planning engineer in 1939. Mr. Harkins had taught in the evening classes of the Central Technical High School of Toronto since 1919.

Robert Butterfield Trench (A '41) plant engineer, New York Telephone Company, New York, died April 21, 1946. Mr. Trench was born January 13, 1909, in Chillicothe, Ohio, and was graduated from the Sheffield Scientific School *magna cum laude* in 1929. That same year he joined the New York Telephone Company as engineering assistant and in 1932 became switchman. He was titled installer in 1937 and engineer in 1941. In 1944 he became plant engineer. Mr. Trench was a member of Sigma Xi.

W. L. Chambers (A '45) salesman, Charleston (W. Va.) Electrical Supply Company, died May 18, 1946. Mr. Chambers was born in Spencer, W. Va., in 1904. He had been in the sales department of the Electrical Supply company since 1926. For the past seven years he had charge of all lighting and sales engineering of lighting equipment handled by the company.

MEMBERSHIP . . .

Recommended for Transfer

The board of examiners, at its meeting of June 20, 1946, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the secretary of the Institute.

To Grade of Fellow

Claytor, G., operating vice-pres., American Gas & Elec. Serv. Corp., New York, N. Y.
Perry, W. W., chief engr., New York State Elec. & Gas Corp., Binghamton, N. Y.
Peterson, W. S., asst. chief elec. engr., Dept. of Water & Pr., Los Angeles, Calif.
Thompson, G., chief engr., Electrical Testing Labs., Inc., New York, N. Y.
Wright, R. H., steel mill engr., Westinghouse Elec. Corp., E. Pittsburgh, Pa.

5 to grade of Fellow

To Grade of Member

Baltzell, L. A., genl. supt., plains div., Southwestern Public Serv. Co., Plainview, Tex.
Barden, W. A., U. S. Army Air Forces, Air Technical Intelligence, Wright Field, Dayton, Ohio.
Bergmann, W. F., asst. elec. engr., Public Utility Engg. & Serv. Corp., Chicago, Ill.
Camineti, P. A., cons. engr., 45-18 Court Square, Long Island City, N. Y.
Christensen, C. P., engr., Illinois Bell Tel. Co., Chicago, Ill.
Coddington, R. W., elec. engr., Bonneville Pr. Adm., Portland, Oreg.
Connolly, W. T., sr. engr., Idaho Pr. Co., Boise, Idaho.
Cooper, L. S., advance design & div. engr., General Elec. Co., Erie, Pa.
Criley, W., engr., equip. engg. div., Rochester Tel. Corp., Rochester, N. Y.
Dlouhy, F. S., relay engr., Oklahoma Gas & Elec. Co., Oklahoma City, Okla.
Egeberg, H., chief engr., State Electricity Comm., Queensland, Australia.
Embry, A. L., design engr., General Elec. Co., Lynn, Mass.
Enriquez, O. R., head, hydroelectric div., Comision Nacional De Irrigacion, gen'l. director, Secretaria Economia Nacional, Mexico, D. F., Mexico.
Evans, W. M., elec. engr., testing & drafting depts., U. S. Electrical Motors, Inc., Los Angeles, Calif.
Fairley, R. K., development engr., General Elec. Co., Schenectady, N. Y.
Garlington, W. L., elec. engr., Reynolds, Smith & Hills, Jacksonville, Fla.
Gnuse, H. H., Jr., chief elec. engr., Nantahala Pr. & Lt. Co., Franklin, N. C.
Greentree, C. D., section engr., general engg. & cons. lab., General Elec. Co., Schenectady, N. Y.
Groch, F. R., asst. to vice-pres., Portland General Elec. Co., Portland, Oreg.
Haeussler, F. B., asst. dist. engr., General Elec. Co., Boston, Mass.
Henderson, W. A., outside plant engr., New York Tel. Co., New York, N. Y.
Jackson, F. R., Jr., elec. engg. designing, General Elec. Co., Pittsfield, Mass.
Karr, J. H., asst. chief engr., Robbins & Myers, Inc., Springfield, Ohio.
Koontz, R. E., elec. engr., National Standard Co., Niles, Mich.
Kratzer, R. E., engr., Detroit Edison Co., Detroit, Mich.
Livingston, J. M., sales engr., G. & W. Elec. Specialty Co., Chicago, Ill.
Lloyd, L. H., project engr., Air Matériel Command, Wright Field, Dayton, Ohio.
MacLean, T. W., communications engr., Washington Water Pr. Co., Spokane, Wash.
Mohns, J. C., sr. elec. engg. draftsman, Public Utilities Engg. Bureau, San Francisco, Calif.
Morrison, W. J., elec. engr., Prudential Insurance Co. of America, Newark, N. J.
Noller, W. E., engr., Pacific Tel. & Tel. Co., San Francisco, Calif.
Northrup, M. G., prof. & head, dept. of elec. engg., Speed Scientific School, Univ. of Louisville, Louisville, Ky.
Plucknett, K. J., assoc. engr., U. S. Dept. of Agric., Rural Electrification Adm., Washington, D. C.
Reber, J. F., ind. elec. engg. specialist, Westinghouse Elec. Intl. Co., New York, N. Y.
Rokicki, A. J., engr., New York Tel. Co., Albany, N. Y.
Rock, J. J., elec. engr., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Silvus, W. E., engr., General Elec. Co., Houston, Tex.
Smedley, G. B., sr. engr., Commonwealth Edison Co., Chicago, Ill.
Sterner, E. E., engr., Tennessee Eastman Corp., Oak Ridge, Tenn.
Stevenson, W. D., Jr., asst. prof., elec. engg., Princeton Univ., Princeton, N. J.
Streed, E. R., asst. operating engr., Delaware Pr. & Lt. Co., Wilmington, Del.
Stringfield, T. W., elec. engr., Bonneville Pr. Administration, Porland, Oreg.
Stuart, R. M., research engr., Harvey-Wells Electronics, Inc., Southbridge, Mass.
Tatum, G. M., supervisor of elec. equip. & trans., Virginia Elec. & Pr. Co., Richmond, Va.
Thompson, R. P., engr., Southern California Tel. Co., Los Angeles, Calif.
Wagstaff, R. R., elec. engr., United Engineers & Constructors, Inc., Philadelphia, Pa.
Wantland, J. S., asst. meter supervisor, Oklahoma Gas & Elec. Co., Oklahoma City, Okla.
Wantzelius, O. G., engr., General Elec. Co., Schenectady, N. Y.
Wynn, J. H., Captain, U. S. Army Signal Corps, 330 Sherman St., Watertown, N. Y.

49 to grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Any member objecting to the election of any of these candidates should so inform the secretary before August 15, 1946, or October 15, 1946, if the applicant resides outside of the United States or Canada.

To Grade of Member

Backer, L. A., Richwood Place, Denville, N. J.
Bailey, B. F., Jr., Commonwealth and Southern Corp., Jackson, Mich.
Beardmore, A. E., General Elec. Co., Schenectady, N. Y.
Blades, J. M., Barbados Elec. Supply Corp., Ltd., Barbados, British West Indies
Borokhovich, J. A. (Re-election), Consolidated Edison Co. of N. Y. Inc., Brooklyn, N. Y.
Boyum, I. L., Westinghouse Elec. Corp., Minneapolis, Minn.
Braden, C. E., Ebasco Services, Inc., New York, N. Y.
Chadwick, G. A., Vickers Inc., Detroit, Mich.
Codd, W. A., Stromberg-Carlson Co., Rochester, N. Y.
Crow, R. B., Bonneville Pr. Administration, Pittsburgh, Pa.
Dakin, J. B., Sr., General Motors Corp., Lansing, Mich.
Dey, C., General Elec. Co., Philadelphia, Pa.
Downie, J. M., General Elec. Company, Erie, Pa.
Ghen, R. C., Boston Edison Co., Boston, Mass.
Goodwin, R. H., Birlec, Ltd., Birmingham, England
Griffins, M. E., Automatic Elec. Co., Chicago, Ill.

Harker, R. M., Youngstown Municipal Railways Co., Youngstown, Ohio
Hartman, M. E., General Elec. Co., Schenectady, N. Y.
Hildebrandt, L. H., Air Matériel Command, Wright Field, Dayton, Ohio
Hoefle, A., The Toledo Edison Co., Toledo, Ohio
Jenkins, H. M., Swarthmore College, Swarthmore, Pa.
Josslon, F. P., Consolidated Edison Co. of N. Y., New York, N. Y.
Katzer, H., Cia. Auxiliar de Empresas Electricas Brasileiras, Rio de Janeiro, Brazil, S. A.
King, R. B., Automatic Elec. Co., Chicago, Ill.
Kucej, L., Shanghai Pr. Co., Shanghai, China.
Lingel, F. J., The Triplett Elect. Inst. Co., Bluffton, Ohio
Lowe, H. F., Sloan Cook & Lowe, Chicago, Ill.
Machen, C. F., Boston Consolidated Gas Co., Boston, Mass.
Maia, D. F. A., Central of Brasil Railroad, Rio de Janeiro, Brasil, S. A.
Manley, J. M., Bell Tel. Labs., Murray Hill, N. J.
McAllister, Carl J. Kiefer Associates, Inc., Cincinnati, Ohio
McBrearty, J. J., Pennsylvania Pr. & Lt. Co., Shenandoah, Pa.
Miller, S. E., American Bosch Corp., Springfield, Mass.
Mosteller, W. A., General Elec. Co., Detroit, Mich.
Murray, P. E., General Elec. Co., Cleveland, Ohio
Nock, N. T., Birlec Ltd., Glebe, N. S. W., Australia
Oakhill, F. E., O-Cedar Corp., Chicago, Ill.
Peters, H. P., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Pew, R. M., American Tel. & Tel. Co., Philadelphia, Pa.
Rice, F. S., Minnesota Pr. & Lt. Co., Duluth, Minn.
Potter, F. M., Sperry Gyroscope Co., Inc., Great Neck, N. Y.
Rombach, J. R., Jr., New Orleans Public Service, Inc., New Orleans, La.
Sear, R. V., Cia. Colombiana de Electricidad, Barranquilla, Colombia, S. A.
Seastone, J. B., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Sehgal, K. L., Delhi Polytechnic, Delhi, India
Shaheen, J., Sylvania Elec. Products, Inc., Ipswich, Mass.
Stoetzel, D., Jr., General Elec. Co., Schenectady, N. Y.
Van Emden, A. L., U. S. Navy Dept., Washington, D. C.
Way, J. S., Commonwealth Edison Co., Chicago, Ill.
Westgard, B. E., A. C. M. Co., Anaconda, Mont.
Westman, H. P., Sr., Int'l Tel. & Tel. Corp., New York, N. Y.
Will, E. H., El Paso Electric Co., El Paso, Tex.
Wilson, E. F., Houston Lighting & Pr. Co., Houston, Tex.

53 to grade of Member

To Grade of Associate

United States and Canada

1. North Eastern

Blanchet, O. J. (Re-election), 91 Jouvette St., New Bedford, Mass.
Buttner, B. W., Eastman Kodak Co., Kodak Park, Rochester, N. Y.
Clark, O. J., General Elec. Supply Corp., Boston, Mass.
Dietrich, H. H., Rochester Products Co., Rochester, N. Y.
Easton, E. P., Jr., Allis-Chalmers Mfg. Co., Boston, Mass.
Forbes, E. C., Int'l General Elec. Co., Schenectady, N. Y.
Hansell, E. B., General Elec. Co., Schenectady, N. Y.
Hoelle, L. C., General Elec. Co., Pittsfield, Mass.
Johnson, L. J., General Elec. Co., Schenectady, N. Y.
King, J. H., New England Pr. Service Co., Boston, Mass.
Kopach, S., General Elec. Co., Schenectady, N. Y.
Krieger, E. T., Int'l General Elec. Co., Schenectady, N. Y.
Pafenbach, W. M. (Re-election), General Elec. Co., Pittsfield, Mass.
Pruett, H. C., General Elec. Co., Schenectady, N. Y.
Robertson, J. W., General Elec. Co., Schenectady, N. Y.
Race, H. C., Kenworthy & Taylor, Inc., Everett, Mass.
Rogers, E. K., Scovill Mfg. Co., Waterbury, Conn.
Schroeter, C. E., U. S. Rubber Co., Naugatuck, Conn.
Scudder, R. E., Allis-Chalmers Mfg. Co., Providence, R. I.
Sutton, W. I., General Elec. Co., Schenectady, N. Y.
Wallis, T. M., Jr., General Elec. Co., Lynn, Mass.
Wargin, E. F., General Elec. Co., Schenectady, N. Y.
Wohlwill, H. E., Corning Glass Works, Corning, N. Y.

2. Middle Eastern

Berger, F. L., Jr., Westinghouse Elec. Corp., Lima, Ohio
Booher, R. E., The Ohio Brass Co., Mansfield, Ohio
Brown, R. M., AAF, Wright Field, Dayton, Ohio
Crafton, B. L., American Tel. & Tel. Co., Philadelphia, Pa.
Cranmer, E. P., Public Service Elec. Co., Camden, N. J.
Craven, F. T., John A. Roebling's Sons Co., Philadelphia, Pa.
Cruess, W. F., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Donaldson, C. (Re-election), Briggs Filtration Co., Bethesda, Md.
Dyer, V. M., Westinghouse Elec. Corp., Washington, D. C.
Fink, J. C., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Foulds, J. T., The Phila. & Reading Coal & Iron Co., Pottsville, Pa.
Freidline, D. R., Dayton Pr. and Lt. Co., Dayton, Ohio
Hammond, C. E., Westinghouse Elec. Corp., East Pittsburgh, Pa.
Hart, J. P., Philadelphia Elec. Co., Doylestown, Pa.
Herman, J., Naval Ordnance Lab., Navy Dept., Washington, D. C.
Hogan, D. L., National Bureau of Standards, Washington, D. C.
Jackson, D. W., David Taylor Model Basin, Washington, D. C.
Lawrence, W. L., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Lewis, F. W., General Elec. Co., Philadelphia, Pa.
Lightfoot, E. B., The Chesapeake & Potomac Tel. Co., Washington, D. C.
Nelson, J. L., West Penn Pr. Co., Pittsburgh, Pa.
Oman, H. T., 870 E. McCreight Ave., Springfield, Ohio
Rector, B. E., Westinghouse Elec. Corp., E. Pittsburgh, Pa.
Rondell, L. F., Mansfield Tire & Rubber Co., Mansfield, Ohio
Schall, R. F., Roller-Smith, Bethlehem, Pa.
Smart, W., The Hertner Elec. Co., Cleveland, Ohio
Yingst, P. V., 2634 Jefferson St., Harrisburg, Pa.
Young, J. C., Day & Zimmermann Inc., Philadelphia, Pa.

3. New York City

Boyle, G. G., Lt. (jg), USNR, 151 West Third St., Bayonne, N. J.
Cowan, J. H., The Kerite Co., New York, N. Y.
Davie, D. L., U. S. Navy, c/o FPO, New York, N. Y.
Dixon, E. G., General Elec. Co., New York, N. Y.
Guise, P. A., United Fruit Co., New York, N. Y.
Harris, H., Jr., Sperry Gyroscope Co., Great Neck, N. Y.
Hayes, A. E., Industrial Electronics Corp., Newark, N. J.
Kaeser, F. L., Frederic R. Harris, New York, N. Y.
McGeeney, J. J., New York Tel. Co., Brooklyn, N. Y.
Morris, A. M., Westinghouse Elec. Int'l. Co., New York, N. Y.
Patterson, R. B., New Jersey Bell Tel Co., Jersey City, N. J.
Potter, G. R., Ebasco Services, Inc., New York, N. Y.
Rynkowsky, N., 2886 Briggs Avenue, New York, N. Y.
Smith, D. P., Brooklyn Law School, Brooklyn, N. Y.

4. Southern

Azbell, R. A., E. Barrett Foster, Sheffield, Ala.
Bailey, H. T., Jr., Louisiana Pr. and Lt. Co., Gretna, La.
Caldwell, S. Y., Jr., Alabama Pr. Co., Birmingham, Ala.
Cox, J. C., Norfolk Naval Ship Yard, Portsmouth, Va.
Ivey, A. J., Alabama Pr. Co., Birmingham, Ala.
Jones, W. C., Nashville Elec. Serv., Nashville, Tenn.
Markli, F. A., 3rd, Tennessee Eastman Corp., Oak Ridge, Tenn.
McClanahan, H. C., TCI & RR Co., Fairfield Steel Works, Fairfield, Ala.
Myers, F. B., Southern States Equip. Corp., Hampton, Ga.
Myers, R. G., Alabama Pr. Co., Birmingham, Ala.
Newton, R. E., Southern Bell Tel. & Tel. Co., Louisville, Ky.
Talcott, T. W., Southern Bell Tel. & Tel. Co., Louisville, Ky.

5. Great Lakes

Baker, G. E., Illinois Pr. Co., Belleville, Ill.
Barstow, J. P., Consumers Pr. Co., Manistee, Mich.
Belcher, T. H., Michigan Bell Tel. Co., Detroit, Mich.
Bloor, W. S., Leeds & Northrup Co., Chicago, Ill.
Bruya, F. C., Jr., General Elec. Co., Fort Wayne, Ind.
Carson, N. R., Commonwealth Edison Co., Chicago, Ill.
Cliff, R. A., General Elec. Co., South Bend, Ind.
Christensen, C., Automatic Elec. Co., Chicago, Ill.
Davis, C. M., The Detroit Edison Co., Detroit, Mich.
Dunn, D. F., Westinghouse Elec. Corp., Minneapolis, Minn.
Dunn, E. C., Sampsel Time Control, Inc., Spring Valley, Ill.
Hammond, H. G., The Detroit Edison Co., Detroit, Mich.
James, S. W., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Knapp, William W., Aluminum Co. of America, Minneapolis, Minn.
LaSere, E. I., Northern States Pr. Co., Minneapolis, Minn.
LeBold, W. K., Automatic Elec. Co., Chicago, Ill.
Lecher, E. A., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Markland, H. J., Public Serv. Co. of Ind., Inc., Indianapolis, Ind.
Plasmier, G. C., Automatic Elec. Co., Chicago, Ill.
Simonson, B., Automatic Elec. Co., Chicago, Ill.
Smith, V. C., Consumers Pr. Co., Grand Rapids, Mich.
Stevenson, H. R., The Detroit Edison Co., Detroit, Mich.
Vanderberg, L. J., King-Seeley Corp., Ann Arbor, Mich.
Vitulli, A. F., Underwriter's Labs., Inc., Chicago, Ill.
Waller, M. S., Automatic Elec. Co., Chicago, Ill.
Williams, R. T., Automatic Elec. Co., Chicago, Ill.
Zalewski, H. F., Dept. of Subways & Superhiways, Chicago, Ill.

6. North Central

Edmonds, H. M., Public Service Co. of Colo., Denver, Colo.
Gless, G. E., Jr., University of Colo., Boulder, Colo.
Waggoner, W. M., Bureau of Reclamation, Denver, Colo.

7. South West

Brush, C., American Tel. & Tel. Co., Dallas, Tex.
Cassil, C. C. (Re-election), S. W. Bell Tel. Co., Houston, Tex.
Caswell, W. H., Gulf States Utilities Co., Beaumont, Tex.
Cole, J. H., 323 N. W. Second Street, Oklahoma City, Okla.
Fullwood, W. A., Jr., S. W. Marshall, Jr., Dallas, Tex.
Joseph, C. E., Peterson & MacFadyen, Little Rock, Ark.
Petree, B., University of Kansas, St. Joseph, Mo.
Robinson, K. G., Beech Aircraft Corp., Wichita, Kan.
VanBurkleo, G. R., Public Service Co. of Okla., Tulsa, Okla.
Van Buskirk, T. E., Ens., USNR, 5418 St. John, Kansas City, Mo.
Whitmore, W. D., Todd Galveston Dry Docks, Inc., Galveston, Tex.
Woodson, J. T., Capt., U.S.A., 422 South Smith St., Vinita, Okla.

8. Pacific

Austin, H. C., Southern Calif. Edison Co., Ltd., Los Angeles, Calif.
Beckhorn, W. H., Clyde E. Bentley, San Francisco, Calif.
Creighton, L. L., Pacific Gas & Elec. Co., San Francisco, Calif.
Doak, W. M., Basic Magnesium Project, Henderson, Nev.
Gregory, G. W., Jr., Ens., USNR, DirEastPacDocks, San Francisco, Calif.
Haley, W. H., Jr., General Elec. Co., San Francisco, Calif.
Johnson, E. F., U. S. Navy, c/o F.P.O., San Francisco, Calif.
Ledyard, D. B., Pasadena Lt. & Pr., Pasadena, Calif.
Lighthipe, J. A., Southern Calif. Edison Co., Anaheim, Calif.
Mielecki, C. A., C. F. Braun & Co., Alhambra, Calif.
Mobley, C. L., Tucson Gas, Elec. Lt. & Pr. Co., Tucson, Ariz.
Ninnis, G. E., Kurze Electrical Works, San Jose, Calif.
Potter, J. B., U. S. Navy Supply Depot, San Pedro, Calif.

9. North West

Derrick, G. R., U. S. Bureau of Reclamation, Salt Lake City, Utah
Johnston, R. W., Lake Washington Shipyards, Houghton, Wash.
Lehl, H. G., General Elec. Supply Corp., Portland, Oreg.
McHenry, G. A., Boeing Aircraft Co., Seattle, Wash.
Moats, W. L., Westinghouse Elec. Corp., Salt Lake City, Utah
Mortell, R. P., Puget Sound Pr. & Lt. Co., Seattle, Wash.
Radin, C. J., DeWitt C. Griffin & Associates, Seattle, Wash.

10. Canada

Ainsworth, H., Dominion Govt., Ottawa, Ontario, Canada
Asselstine, J. J., Falconbridge Nickel Mines, Flaconbridge, Ontario, Canada
Fetherston, L. G., Canadian Westinghouse Co., Hamilton, Ont. Canada
Kaupp, F. R., Kaupp Elec., Merritton, Ontario, Canada
Weegar, G. R., T. Pringle & Son, Ltd., Montreal, Quebec, Canada

Elsewhere

Booth, H., Messrs. McLellan & Partners, Glamorganshire, South Wales, Great Britain
Campo, C. A., Empresas Unidas de Energia Electrica, Bogota, Colombia, S. A.
Chiang, F. Y. K., Sung Sing Cotton Mill No. 9, Shanghai, China
Davis, E. R., Herring & Bostwick, Ltd., Bulawayo, Rhodesia, South Africa
Fu, C. S., Metropolitan-Vickers Electrical Co., Ltd., Manchester, England
Rollo, J. T., Southern Electricity Supply of New South Wales, Goulborn, N. S. W. Australia
Strauven, M. J. J., Societe Generale des Forces Hydroelectriques du Katanga (Congobelge), Brussels, Belgium

Total to grade of Associate

United States and Canada, 144
Elsewhere, 7

OF CURRENT INTEREST

EJC Joins Campaign for Books for War-Damaged Libraries

The Engineers Joint Council, representing five national engineering societies has combined with the American Book Center for War Devastated Libraries, Inc., in efforts to help restore engineering and other libraries overseas. The American Book Center, which has its headquarters in the Library of Congress, Washington, D. C., will be the central handling point for volumes contributed through the engineering societies and will receive, sort, assign, pack, and ship the books.

With this action, the Engineers Council renewed its recent appeal for engineering books and technical literature. Contributors are asked first to send a list of the books they wish to donate to the Chairman of Book Commission, Engineers Joint Council, 29 West 39th Street, New York 18, N. Y. Shipping instructions and bookplates then will be sent them. Gifts of money will be used by the committee to purchase new books for special needs.

As shipping facilities are limited and demand that all materials be selected carefully, the following listing of what is and what is not needed has been prepared:

What Is Needed. Emphasis is placed upon publications issued during the past decade, upon scholarly books which are important contributions to their fields, upon periodicals (even incomplete volumes) of significance, upon fiction and nonfiction of distinction. All subjects—history, the social sciences, music, fine arts, literature, and especially the sciences and technologies —are wanted.

What Is Not Needed. Textbooks, outdated monographs, recreational reading, books for children and young people, light fiction, materials of purely local interest, popular magazines such as *Time*, *Life*, *National Geographic*, popular nonfiction of little enduring significance. Only carefully selected federal and local documents are needed, and donors are requested to write directly to the center with regard to specific documents.

The co-operative arrangement, officially approved by the American Book Center and by the Engineers Joint Council, is expected to aid the efforts of both materially. The American Book Center works closely with the Department of State and is recognized by foreign countries. It enjoys shipping privileges and priorities which facilitate deliveries abroad. The United Nations Relief and Rehabilitation Administration is convinced that these programs are so directly related to reconstruction of devastated countries that it is providing shipping space.

The EJC Committee on International Relations, headed by Malcolm Pirnie, is carrying on the effort for the engineers. It represents the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers.

Since the campaign got under way a few months ago, under direction of a Committee on International Relations of the ASME, with other societies participating, considerable progress has been made. A special purchase of books on management has been made for the Masaryk Academy in Prague, Czechoslovakia. More than 100 individual offers of technical books and other literature have been received, but shipping difficulties caused delay until the recently completed arrangement with the American Book Center.

Twelve of the country's leading library groups sponsor the American Book Center for War Devastated Libraries, Inc. They include the American Library Association, and the associations of law, college and reference, medical, research, children's libraries, and other groups.

Kenneth R. Shaffer is the executive director of the American Book Center. The work was started in February 1945, with 20 countries originally benefiting. A few weeks ago 14 more countries were added, financed by the Rockefeller Fund. About 5,000 libraries are beneficiaries.

The material is allocated to countries and institutions where it will be most helpful. Donors therefore are asked not to designate the country to receive their books. Shipping costs must be prepaid, but when requested by the donor, the sum will be refunded, although it is hoped that generally the donor will bear the shipping cost.

In a recent appeal for books, Mr. Shaffer said:

> During the war, the libraries of half the world were destroyed in the fires of battle and in the fires of hate and fanaticism. Where they were spared physical damage, they were impoverished by isolation. There is an urgent need—now—for the printed materials which are basic to the reconstruction of devastated areas and which can help to remove the intellectual blackout of Europe and the Orient.

This 4 by 5½ inch bookplate which will be sent to contributors was designed specially for the book drive by G. H. Kuechler

Included in the 34 benefiting countries are some whose libraries, as in Holland, were not seriously damaged, but were completely shut off from current publications. These 34 countries are:

Full participants: Belgium, Burma, China, Finland, Greece, Italy, Luxembourg, Netherlands, Norway, Poland, Siam, Yugoslavia.

Limited participation: Czechoslovakia, Denmark, England, France, Philippines, Soviet Union, Austria, Romania, Hungary, Bulgaria, Sweden, Switzerland, Spain, Portugal, Australia, New Zealand, India, Egypt, Turkey, Korea, Germany, and Japan.

Typical in its appeal was a letter received recently from the Philippines, addressed to the ASME. It read:

At the outbreak of World War II, the Scientific Library of the Bureau of Science, an office under this Department, had one of the largest and best known collections of technical and scientific publications in this part of the Orient. This same library was destroyed by the Japanese during the war. We shall appreciate it, therefore, if you will kindly help us in the task of building anew from scratch some such collection by donating to the library whatever publications you can spare now and in the future.

Electrical Manufacturing Threatened by Copper Shortage

Acute shortages of copper, due to strikes in the copper mining, smelting, refining, and fabricating industries, which have been slowly paralyzing the electrical manufacturing industry, soon will force widespread plant curtailment and shutdowns, according to R. L. White, president of the National Electrical Manufacturers Association, following a poll taken at a meeting of the board of governors of the association held on June 7.

The seriousness of the copper situation already is being experienced by the public, because of the lack of copper and brass components, which prevent the shipping of otherwise completed household appliances, Mr. White pointed out. Unless the situation is relieved immediately, he said, many electric appliance dealers will be forced into bankruptcy. Housing projects also will be hamstrung for the lack of wire, cable, and electric building materials, he said.

The shortage of wire bars is particularly acute, and an estimate was made that the Government held about 1,000 tons of such bars at the end of May, against a monthly consumption by the industry of about 60,000 tons. Perhaps the maximum distribution by the Government in sight for June would be 10,000 tons. This, with limited imports of copper allowed by the Government, in no way would meet the demand.

Shortage of Young Engineers Will Exist Until 1949

In November 1945, engineering student enrollment in the United States and Canada was 73,269. However, this number will not remedy greatly the 150,000 deficit in engineers reported by Vannevar Bush, (F '24) director of the United States Office of Scientific Research and Development. It is probable that about 5,000 degrees in engineering will be conferred this coming June. Although a slight increase over last year, this figure is only 30 per cent of the peak number of degrees conferred in 1942–43.

William B. Plank, head of the department of mining and metallurgical engineering of Lafayette College, Easton, Pa., states in the May issue of *Mining and Metallurgy* that "Undoubtedly, anything like a normal supply of engineering graduates will not occur until the present freshman class is graduated in 1949."

Professor Plank estimates that the second semester engineering enrollment will be about 100,000 with the bulk of this increase coming from the enrollment of veterans. "The great danger here is that some institutions may be exceeding their proper capacity to handle this abnormally large enrollment all in one class. The results of this crowding, which now principally affects living quarters, will be much more acute in the departmental laboratories when the men reach their third and fourth years."

Professor Plank's statistics show that some 949 electrical engineers were graduated in June 1946, in addition to 289 mineral engineers, 748 chemical engineers, 714 civil engineers, 1,373 mechanical engineers, and 898 engineers of other types. These figures do not include the engineers now enrolled in graduate work who will enter the industrial field this spring.

Government Contracts for Atomic Energy Development

The War Department recently announced a contract with the General Electric Company under which the latter will take over operation of the Government's $347,000,000 plant at Hanford, Wash., about September 1, for an "extensive research program" in atomic energy.

During the war the plant was operated by E. I. du Pont de Nemours and Company, Inc., which is retiring from the program because the peacetime aspects lie primarily in the field of power generation and not in the chemical field which is the du Pont company's main concern.

The General Electric Company, President Charles E. Wilson explained, is assuming responsibility for the plant's operation because with the company's background of prewar atomic research, it is convinced that "the greatest possible development of nonmilitary application, not only is the most constructive solution to the problem which atomic energy presents to the world, but also the greatest opportunity for more jobs and more goods for more people in the future.

The Hanford works will be operated by a manager with an advisory committee consisting of H. R. Winne (F '45) vice-president in charge of engineering policy, C. G. Suits (M '41) vice-president and director of the research laboratories, and Zay Jeffries (F '42) vice-president and general manager of the chemical department.

The contract with the General Electric company is similar to that with the du Pont company in that the fee for all work to be performed is $1. The Government will retain control of the plant.

Electron Tube Converts Mechanical Motion Directly

Development of a tiny metal electron tube, the Vibroton, which converts mechanical motion directly into variable electron flow has been announced by the Radio Corporation of America laboratories at Princeton and Harrison, N. J. The tube weighs less than an ounce and is only about one inch in length and one quarter of an inch in diameter.

Though the new tube is not yet in production, the company will make a limited number available to manufacturers of electronic equipment who are interested in experimenting with it for use in future products. It is expected that the tube will find wide application in future designs of phonograph pickups. Other fields of application are in microphones and in industrial equipment where translation of mechanical motion to electron circuits is desirable for purposes of control or measurement.

The tube is a metal triode, at one end of which is an extremely thin flexible metal diaphragm through which external motion is transferred to a movable electrode within the tube. Leads for supplying voltages are brought out through the other end. The tube operates as an integral part of the pickup head and the radio phonograph amplifier without the need of a preamplifier or coupling transformer.

Life tests have shown the tube to withstand severe treatment over long periods and to be stable under temperature and humidity changes.

Veterans Administration Sponsors on-the-Job Training

In connection with efforts to publicize the on-the-job training phase of its rehabilitation program, the Veterans Administration reports that widespread interest in electrical work has developed among the Armed Forces.

Under the rehabilitation program the aptitudes and qualifications of all trainees are reviewed carefully by the Administration staff before they are approved for on-the-job training, so that the danger of misfits is reduced to a minimum.

Supplementary living-cost allowances can be arranged to cover a period of months or years suitable to the particular job training schedule. While details of any such program are of course subject to the approval of the Veterans Administration, it is said that arrangements are much more flexible for men in the rehabilitation program than outside it. Employers who are

interested can obtain full details by telephoning the nearest office of the Veterans Administration.

Eligible veterans are those who meet the four following requirements:

1. The person must have been in the active military or naval service on or after September 16, 1940, and prior to the termination of the present war.

2. He or she must be discharged or released from the active service under conditions other than dishonorable.

3. He or she must have a disability incurred in or aggravated by such service for which pension is payable under laws administered by the Veterans Administration, or would be but for the receipt of retirement pay.

4. He or she must be in need of vocational rehabilitation to overcome the handicap of such disability.

JOINT ACTIVITIES

UET Honors Louvain Rector With Luncheon in New York

Monsignor Honoré van Waeyenbergh, rector of Louvain University, Belgium, was guest of honor at a luncheon given by the United Engineering Trustees, Inc., at the University Club in New York on June 19.

Monsignor van Waeyenbergh, who is in the United States visiting American universities with the heads of three other Belgian universities, was introduced to the luncheon guests by John P. H. Perry, president of the UET and vice-president of the Turner Construction Company, New York. In his address, the rector discussed his university's present difficulties caused by a record enrollment combined with an almost total lack of facilities which were destroyed by the war.

AIEE Past President Harold S. Osborne (F '21) was among the luncheon guests.

OTHER SOCIETIES •

Professional Engineers Head Asks Support From Profession

"The public deserves the same protection in the engineering profession as it now has in the medical and legal professions," declared Paul H. Robbins in a statement on his recent appointment as executive director of the National Society of Professional Engineers.

Calling for support of the registration laws existing in 47 states and in the territories, Mr. Robbins said "These laws, however, must be implemented by a united effort on the part of all engineers to create in their own profession and among the public as well, a professional consciousness of the responsibilities entailed. The National Society of Professional Engineers, with its member state societies and its local chapters, is recognized and supported by thousands of engineers as the organization best equipped to accomplish this throughout the whole profession."

"The professional engineer," Mr. Robbins continued, "has two principal needs to maintain his professional standing. He must continue throughout his entire engineering career to keep abreast of technological developments in his chosen field and to be constantly alert to his professional, economic, and social responsibilities to society. To this latter need, the National Society of Professional Engineers is pledged. The society has grown since 1934 to a membership exceeding 12,000 members indicating that more and more engineers are recognizing the need for this unified approach from a national standpoint to the common problems of all engineers."

Mr. Robbins comes to his new appointment from three years as Director of Training and Employee Relations at the New York Port of Embarkation. He is a graduate in engineering from Syracuse University and Massachusetts Institute of Technology.

Future Meetings of Other Societies

American Chemical Society. National Chemical Exposition, September 10–14, 1946, Chicago, Ill.

American Society of Mechanical Engineers. Fall meeting, September 30–October 2, 1946, Boston, Mass.

American Welding Society. Annual meeting, November 17–22, 1946, Atlantic City, N. J.

Illuminating Engineering Society. National convention, September 18–21, 1946, Quebec, Quebec, Canada.

Instrument Society of America. Exhibit and conference, September 16–20, 1946, Pittsburgh, Pa.

Iron and Steel Exposition. October 1–4, 1946, Cleveland, Ohio.

National Electrical Contractors Association. Annual meeting, October 14–18, 1946, Atlantic City, N. J.

National Electronics Conference. October 3–5, 1946, Chicago, Ill.

National Exposition of Power and Mechanical Engineering. December 2–7, 1946, New York, N. Y.

Refrigeration Equipment Manufacturers Association. Fourth refrigeration and air conditioning exposition, Cleveland, Ohio, October 29–November 1, 1946.

Television Broadcasters Association, Inc. Second conference and exhibition, New York, N. Y., October 10–11, 1946.

New Edition of ASTM Standards on Heating and Resistance Alloys

Issuance of a current edition of "ASTM Standards on Electrical Heating and Resistance Alloys" has been announced by the American Society for Testing Materials.

The publication comprises some 30 specifications and tests which include four tests for electrical resistance alloys, two specifications and three tests for electrical heating alloys, two proposed specifications and one proposed method of test for electric furnace alloys, one specification and twelve tests for materials for radio tubes and lamps, three tests for heat-resisting alloys, and two tests for thermostat metals. In addition a technical paper, "Calculation of Electrical Contacts Under Ideal Conditions," by E. I. Shobert II, is included.

Copies of the 184-page publication in heavy paper cover can be obtained from ASTM headquarters, 1916 Race Street, Philadelphia 3, Pa. Single copies are $2; orders for from 10 to 49 copies are filled at $1.50 per copy.

IES Announces New Officers. Newly elected officers who will be inducted at the society's annual convention in Quebec, Quebec, Canada, in September have been announced by the Illuminating Engineering Society. The officers are:

President—Gilbert K. Hardacre, manager of commercial sales, Public Service Company of Northern Illinois

General Secretary—Walter Sturrock

Treasurer—Charles H. Goddard

Vice-president—Lee E. Tayler

Directors—Allan Parker and P. M. Rutherford

EDUCATION • • •

Massachusetts Institute Appoints Dean of Engineering School

Appointment of Professor Thomas K. Sherwood as dean of the school of engineering at the Massachusetts Institute of Technology, Cambridge, recently was announced by President Karl T. Compton. Professor Sherwood has been deputy dean of engineering since February 1946 as well as professor of chemical engineering.

During the war Professor Sherwood was division member of the National Defense Research Committee with which he had been associated since 1940. In 1942 he was consultant to the Baruch Committee, and in 1944 he was appointed expert consultant to the war department. He became assistant professor of chemical engineering at Massachusetts Institute of Technology in 1930, and was appointed professor in 1941.

Hydrodynamic Fellowships at Stevens. Several fellowships for graduates of engineering colleges have been established by the Experimental Towing Tank Laboratory at Stevens Institute of Technology, Hoboken, N. J., it was announced recently by Doctor Kenneth S. M. Davidson, director of the Tank. The value of the fellowships, which are granted for one year, will be graded according to educational background and experience. While no regular graduate school courses are a requisite part of the fellowship, opportunity will be provided, when practicable, for a fellow to enroll in graduate courses at Stevens Institute or at some neighboring graduate school. Applications should be sent to Professor John P. Fife, director of personnel of the experimental towing tank.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly understood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy an inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

A New Type Dismountable Motor

To the Editor:

A modern electric motor of reputable make can be considered as very nearly a perfect machine when working under proper conditions, and involuntary stoppages and breakdowns are rare. Nevertheless such stoppages have not yet been wholly eliminated, one of the most serious results of which generally is the loss of production which occurs while the motor is being withdrawn, stripped down until the fault is discovered, and the damage made good. With the object of reducing to a minimum any such loss of time or production in the case of possible breakdown due to the driving motor, a Spanish firm of motor manufacturers, Bomba Prat S. A., Badalona, has designed and patented a new type of dismountable motor which now is being manufactured on a considerable scale in small sizes. Its design is such as to permit a ready withdrawal of any of its component parts, and another feature of its construction is the provision of special ball bearings by which 10,000 hours of service can be guaranteed without renewing the lubricant.

The design departs considerably from the normal construction in that the component parts form distinct groups, any one of which can be withdrawn and replaced by a substitute within a few minutes. For instance should trouble develop in the stator, this can be withdrawn and another substituted without having to dismount either rotor or bearings; or if any fault occurs in the rotor or bearings these likewise can be withdrawn without affecting either the stator or frame. This result has been achieved by the careful design of the main groups of essential elements which consist of

1. The shell or frame forming the main portion which is fixed to the seating and houses the other parts.

2. The fixed group consisting of the stator which is fixed to the frame in such a manner as to permit of its easy removal.

3. The rotating group comprising bearing assembly, shaft, pulley, and rotor, so arranged that by slackening off a couple of nuts it is possible to withdraw the whole without interfering with either the stator or the frame.

The stator is mounted in the frame by means of hooked bolts, and protection is afforded by means of a cover. The frame provides a seating for the stator, and ensures its correct location. The electric connections consist of suitable flexible leads projecting through a hole in the frame, but which can be pushed back readily when the stator has to be withdrawn.

The first and simplest step in dismounting is the removal of the cover, which is merely a press fit over the stator. The rotor can be removed from either side equally readily.

The design of the bearing housing is such that, once it is withdrawn from the machine, it also can be dismounted completely, all that is necessary being to remove the gland nut and the cover secured by the bolts, after which rotor and shaft can be withdrawn from the other end of the bearing housing, allowing the bearings to be dismounted. Fan blades are provided on the rotor which serve to force air round the stator and out through the opening.

In size the new design of dismountable motor is a trifle longer than one of the standard design, and the price for a given horsepower and speed is stated to be practically identical with the electric motors of standard construction built by the same firm.

A. J. GIBBS SMITH
(Solihull, Warkwickshire, England)

An Over-All Organization for the Engineering Profession

To the Editor:

I have read with considerable interest the report of the subcommittee of the AIEE planning and co-ordinating committee. The subject of a professional organization embracing engineers of all classes certainly has come to the forefront during the past five to ten years. This keen interest in the subject shows that engineers are recognizing the importance of an over-all engineering organization as a means of attaining that professional status to which they are entitled.

If we are to be professionals, rather than just hired men, it appears to me that the following items are necessary:

1. Certification of some sort, showing that the individual to whom it is issued has passed the minimum requirements set up by the legally constituted board created for that purpose.

2. An organization whose membership is composed of such members, regardless of the branch of engineering to which they may belong. Such an organization should be able to speak for the profession as a whole and not be dependent upon the wishes of any technical organization with aims which may not be the same as those of the majority of all engineers.

3. Rules of conduct to which each professional engineer might subscribe and which would tell the world what the individuals belonging to such an organization believe and how they expect to conduct themselves in their dealings with each other and with their fellow men.

4. Assurance to the public that high caliber individuals only will be permitted to belong. This will mean a policing of the profession by the members themselves, bringing violators of the code of ethics to trial and punishment in some manner, such as suspension or expulsion from the organization.

An over-all society would be in a much better position to do such policing of its membership, so that after a lapse of time the finger of suspicion would point to an engineer who did not belong to the organization. The public would ask, "What is the matter with him, why does he not belong?" If the profession does not keep its own house clean, someone on the outside will do it with results perhaps not to our own liking.

Such an over-all organization must be made up of individuals who believe in it and who do not have to operate through some technical society which may not be always in sympathy with the objects desired. The technical side usually contains a considerable number of members who are not "interested in engineering" and therefore do not have the same viewpoint as the engineer who takes the trouble to become registered.

Such an over-all organization will not detract from interest in a technical organization. Each professional engineer should be a member of at least two: one the over-all society which has as its objective the raising of the standards of the profession and thereby improving the welfare of the engineer and the services he renders to his country; and the other, a technical society which seeks to improve the engineer's technical knowledge in his specialized activity.

The meetings of the first group should be devoted to subjects in which all engineers are interested, including the following:

1. Discussion of state and national labor laws a they pertain to the engineering profession.

. Determination of proper and equitable fees for consulting and designing work.

3. Establishment of scales of wages and salaries for engineers having various responsibilities.

4. Policing of the profession and trial of members who violate the code of ethics.

5. Development of engineers in the humanistic subjects.

6. Study of effect of existing and proposed laws on the profession, and the encouragement of the passage of laws which will raise engineering standards.

7. Methods of assisting institutions of learning.

Such an organization would be a "grass roots" organization, one in which each member would have his interest aroused first as an engineer and member of the local unit to which he belongs, and second, as a member of the state organization, and third, as a member of the national. To try to form such an organization by means of a committee selected from any of the existing technical organizations would be a very difficult task, on account of the fact that each organization at the present time probably has its own suggestions as to what course of action should be taken, and for any such selected delegates to combine their viewpoints, so that they can present a

unified front would be extremely difficult.

Why waste time deciding upon what sort of an organization shall be created, when there already exists such an organization, namely, the National Society of Professional Engineers? This organization limits its membership to registered engineers with a few exceptions and is directly subject to the will of the membership through the state and district societies which are component parts of the national. If we are ever to achieve the goal which all of us hope is not too far away, let us stop discussing which kind of organization is better, and instead let all of us join the National Society of Professional Engineers, a rapidly growing organization, that seems to fill the bill adequately.

R. R. HERRMANN (A '16, M '21)
(Manager rate and sales research, Northern States Power Company, Minneapolis, Minn.)

Electrical Essays for Recreation

To the Editor:

The following problem in electromagnetic induction may be of some interest in connection with the recent letters of Mr. Richter and Mr. Hansen in *Electrical Engineering*, (*Oct '45, p 381, and Feb '46, p 95*).

Consider a cylindrical iron tube, Figure 1, moving concentrically along a straight conductor carrying a steady current. On the inner and outer surfaces of this tube rest fixed brushes which are connected by stationary wires to a galvanometer or voltmeter. Will the measured electromotive force be independent of the permeability of the tube, or in other words will the electromotive force be identical for similar tubes of iron and brass?

The problem is interesting as an illustration of the correct method of applying two alternative theories of electromagnetic induction.

According to the Maxwell–Lorentz theory, in order to calculate the electromotive force induced in the closed circuit of Figure 1 we must consider two effects:

1. The motion of the iron tube through the total or resultant magnetic field, B, in its interior. This will result in a motional component of electromotive force proportional to Bv, or $B_0\mu v$, where B_0 is the magnetic field when $\mu=1$, μ is the permeability of the iron, and v is the velocity of the tube.

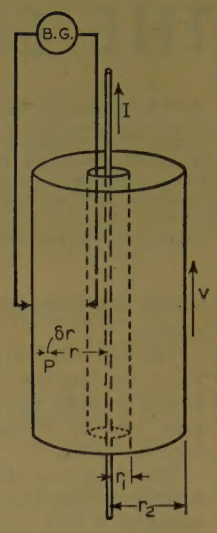
2. The rise of the magnetic field in the space through which the top of the tube travels, in a short time δt, as it moves into the voltmeter circuit will induce an electromotive force in the closed circuit equal to the rate at which the flux in this space increases. That is, it will result in a "transformer" component of electromotive force proportional to

$$B\left(1-\frac{1}{\mu}\right)v$$

in a direction opposite to the first component of electromotive force.

The electromotive force measured therefore will be proportional to B_0v, and will be independent of the permeability of the moving tube.

Figure 1



By the moving-field theory, however, the tube is to be taken as moving through B_0, the stationary field of the stationary axial wire, only, and the field $B_i=(\mu-1)B_0$ of the iron atoms is to be taken as moving with the tube. On account of the symmetry the field B_i is confined to the interior of the tube, and hence cannot induce any electromotive force in the stationary leads. Further, since no currents are changing in the primary circuit, there is no "transformer" component of electromotive force. Hence the measured electromotive force immediately is seen to be proportional to B_0v.

Now let an observer who travels with the tube calculate the electromotive force by each theory in turn. If he uses the Maxwell–Lorentz theory, he takes the magnetic field of the conductor as stationary relative to himself, and he finds the electromotive force to be due to the motion of brushes, leads, and voltmeter, through this field. In other words, the physical phenomena, though leading to the same result, appear totally different to the two observers.

On the other hand, if the moving observer applies the moving-field theory, he accepts the motion of the field B_0 relative to himself, and finds the electromotive force to be induced in the tube by this moving field. Thus the moving-field theory, as applied by different observers, gives a definite and unambiguous answer as to the seat of the induced electromotive force; the Maxwell–Lorentz theory, however, is ambiguous, for the seat of the electromotive force depends upon the motion of the particular observer who applies the theory.

On page 315, volume 85 (1939) of the *Journal* of the Institution of Electrical Engineers will be found a more complete statement of these theories and an account of an experiment which I performed which showed conclusively that the induced electromotive force is independent of the permeability of the cylinder. Its interest to Mr. Richter and Mr. Hansen appears to lie in the fact that application of the flux-linking or flux-cutting laws alone will, in the conventional Maxwell–Lorentz theory, yield an incorrect result. Further, in using the moving-field theory, the various components of the magnetic field must be distinguished: only those components due to moving circuits or magnets should be taken as moving.

E. G. CULLWICK (M '33)
(Captain and director of electrical engineering, Royal Canadian Navy, Naval Service Headquarters, Ottawa, Ontario, Canada)

NEW BOOKS

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

INDUSTRIAL ELECTRIC LAMPS AND LIGHTING. By E. S. Lincoln. Essential Books, New York, N. Y., 1945. 342 pages, illustrated, 8¼ by 5½ inches, cloth, $3. All types of industrial lamps are covered with detailed instructions for their use with proper reflectors for indoor and outdoor lighting. A large amount of practical data is presented in the form of tables and charts. In addition to the commonly used light sources, space is devoted to emergency lighting and equipment, bactericidal lamps, black light, and fluorescent materials.

SMOKE PREVENTION ASSOCIATION OF AMERICA. Conference on Smoke Abatement and Conservation of Fuels, *Proceedings*, Columbus, Ohio, 1945. Smoke Prevention Association, City Hall Square Building, Chicago, Ill., mimeographed, 105 pages, illustrated, 11 by 8½ inches, paper, $2. Fifteen papers are presented covering a variety of topics. The larger aspects of smoke abatement and fuel conservation are considered in the first group. Succeeding papers deal with such specialized fields as dust collection, the relation between meteorology and smoke abatement, the design of locomotive equipment, coal analysis, and incineration problems. An outline is submitted as a suggested approach to participation of the Weather Bureau in air pollution research.

PAMPHLETS

The following recently issued pamphlets may be of interest to readers of "Electrical Engineering." All inquiries should be addressed to the issuers.

The Story of the 1946 (National Electrical) Code Changes. Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y., 15 pages, no charge.

Industrial Research Progress at Armour Research Foundation of Illinois Institute of Technology, 1944–45. Armour Research Foundation, Chicago 16, Ill., 20 pages, no charge.

Axonmetric Drawing. By Paul F. Boehm. John R. Cassell Company, Inc., 110 West 42d Street, New York 18, N. Y., 18 pages, no charge.

Setting Up an Apprenticeship Program. Apprentice-Training Service, United States Department of Labor, Washington 25, D. C., 30 pages.